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Lockups Revisited

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Abstract

Lockups are agreements made by insiders of stock-issuing firms to abstain from selling shares for a specified period of time after the issue. Brav and Gompers (2003) suggest that lockups are a bonding solution to a moral hazard problem and not a signaling solution to an adverse selection problem. We challenge this conclusion theoretically and empirically. In our model, insiders of good firms signal by *putting* and *keeping* (locking up) their money where their mouths are. Our model yields two comparative statics: lockups should be shorter when a firm is i) more transparent and/or ii) more risky. Using a sample of 4,013 initial public offerings and 3,279 seasoned equity offerings between 1988 and 1999, we find empirical support for our theoretical predictions.

I. Introduction

When a company offers new shares in an initial public offering (IPO) or seasoned equity offering (SEO), insiders often agree to abstain from selling personally owned shares for a specified period of time after the offering date. This lockup agreement is negotiated between the investment bank and the insiders of the issuing firm and not required by law.

Brav and Gompers (2003) (B&G henceforth) suggest three explanations for lockups: a signaling solution to an adverse selection problem, a commitment (i.e., bonding) solution to a moral hazard problem, and a rent extraction mechanism by powerful underwriters. They "find no support for the idea that insiders signal their 'quality' by locking themselves for a longer period of time . . . " (B&G, p. 1–2). B&G conclude " . . . that lockups serve as a commitment device to overcome moral hazard problems subsequent to the IPO" (p. 26).

We revisit the signaling explanation of lockups and extend the work of B&G (2003) along four dimensions. First, we develop B&G's signaling story into a formal model. Second, we evaluate B&G's empirical evidence against signaling and

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find it unconvincing. Third, we show how B&G's empirical tests regarding firm transparency lend support to the insider signaling explanation. Fourth, we find empirical support for our signaling model's prediction that lockups will be longer when the degree of asymmetric information is larger and the level of idiosyncratic risk is lower. Our extensions suggest that signaling remains a valid explanation for lockups.

II. Signaling Model of Lockups

Corporate insiders can have superior knowledge about the true value of their firm. Such information asymmetries create an adverse selection problem at the time of an IPO or SEO.[1] Specifically, to reap the full value of a good firm, insiders must send a signal that insiders of a bad firm would not be willing to mimic. Gale and Stiglitz (1989) show that the Leland and Pyle (1977) signal of retaining shares is not credible because insiders can sell overvalued shares immediately after sending the signal. Thus, insiders cannot just *put* their money where their mouth is; rather, they must commit to *keep* it there if the signal is to be credible.

Similar to Courteau (1995), in our model the lockup period performs this keeping function.[2] Mimickers fear discovery (through sales and earnings announcements, project completions and product acceptance, Security and Exchange Commission (SEC) filings, and analyst scrutiny) before they can cash out at the end of the lockup.[3] The higher probability of information asymmetry elimination associated with longer lockups drives out low quality firms, leading to a separating equilibrium.

Formally, consider a firm with value $\mu_b > 0$. If it is a good firm, it can invest C in a project that returns B, yielding a net present value $B - C > 0$. If it is a bad firm it can mimic a good firm by investing C, but the investment is wasted. Suppose the best way to raise C is by offering to sell a fraction $(1-\beta)$ of the company. Then a good firm that raises and invests C is worth $\mu_b + C + (B - C) = \mu_b + B \equiv \mu_g$. In contrast, a bad firm that raises and dissipates C is worth $\mu_b + C + (0 - C) = \mu_b$.

The sequence of events is as follows. The insiders, informed of the firm's quality, decide whether to announce an offering of the form (β, L), where $(1-\beta)$ is the fraction of the firm to be sold for the price C and where L is the length of the lockup period. The outsiders accept the offering if and only if the perceived value of the offering equals or exceeds its price,

$$(1) \qquad (1-\beta)[\gamma\mu_g + (1-\gamma)\mu_b] \quad \geq \quad C,$$

[1]Most new-issue-related papers focus exclusively on IPOs. We intentionally broaden our study to include SEOs for two reasons. First, lockups are common for both IPOs and SEOs, so a model without SEOs would be incomplete. Second, comparing IPO and SEO lockups allows for a direct test of one of our model's predictions.

[2]Courteau assumes two exogenous lockup lengths. We extend her model by endogenizing and allowing for a continuum of lockup lengths.

[3]In the words of Ibbotson and Ritter (1995), p. 1009 "any negative information being withheld is likely to be divulged before the shares can be sold [lockup expires], reducing the benefit of withholding information."

where γ is the outsiders' perception of the probability that the firm is good after observing β and L. If the outsiders reject the offering (or if the insiders make no offer) then the game ends, no investment is undertaken, and the firm can be sold for μ_b. If the outsiders accept the offering, then they contribute C to the firm, C is invested, and the lockup period begins. During the lockup period, nature publicly reveals the truth about the firm with probability $r(L,\theta)$, where θ is a measure of transparency. Greater transparency can be interpreted as greater frequency and content of publicly available news. Thus, for a given lockup length more transparent firms are more likely to have their quality revealed. Similarly, for a given transparency, nature is more likely to reveal the truth with the passage of more time, L. Formally, $r : \Re^2_+ \rightarrow [0,1)$, $r(0,\theta) = 0$, $r_L(L,\theta) > 0$, $\lim_{L\rightarrow\infty} r(L,\theta) = 1$, and $r_\theta(L,\theta) > 0$, where subscripts denote partial derivatives.

Assume insiders have standard mean-variance utility with respect to the value of their share of the firm at the end of the lockup period: $U(M,S^2) = M - kS^2$, where $k > 0$ is a constant. The variance S^2 combines two (independent) sources of uncertainty: firm-specific risk and information risk. Firm-specific risk is inherent in the stochastic process governing the evolution of project values over time. In particular, firm-specific risk is the variance of the post-lockup payoff due to uncertainty about the project's performance and is denoted $\sigma^2(L,\alpha)$, where higher α indicates greater variance. Formally, $\sigma^2(0,\alpha) = 0$, $\sigma^2_L(L,\alpha) > 0$, and $\sigma^2_\alpha(L,\alpha) > 0$. Information risk is the variance of the post-lockup payoff due to uncertainty about whether nature will reveal the truth. As the Appendix shows, information risk equals $\beta^2(\mu_g - \mu_b)^2(r - r^2)$ and thus depends on the penalty for and probability of a bad firm getting caught mimicking a good firm. Only firms that misrepresent themselves, and thus risk being exposed by nature, face information risk.

As is common in the literature, we appeal to the intuition of Cho and Kreps (1987) and focus on the offering that maximizes the utility of a good firm's insiders subject to an incentive compatibility constraint that rules out mimicking by bad firms. The relevant constrained maximization problem is to choose β and L to maximize

$$\beta\mu_g - k\beta^2\sigma^2(L,\alpha), \qquad \text{subject to} \tag{2}$$

$$\beta\mu_g - r\beta(\mu_g - \mu_b) - k\beta^2(\mu_g - \mu_b)^2(r - r^2) - k\beta^2\sigma^2(L,\alpha) \quad \leq \quad \mu_b. \tag{3}$$

The solution, say (β^*, L^*), maximizes utility of good firm insiders subject to the requirement that bad firm insiders would rather accept the true value of their firm than try to mimic a good firm by offering (β^*, L^*). This outcome is supported by the beliefs that a firm offering (β^*, L^*) is a good firm (so $\gamma = 1$) while a firm offering anything else is a bad firm (so $\gamma = 0$). The solution sets $\beta^* = (\mu_g - C)/\mu_g$ to reflect the fair price of a good firm. With β^* determined, L^* is simply the smallest L satisfying (3). Naturally L^* satisfies (3) with equality. Inserting L^* into this equality and differentiating with respect to the various exogenous variables yields comparative statics for each primitive variable: θ, α, μ_b, C, and μ_g. The first two comparative statics are

$$L_\theta^* = \frac{-\left[\beta(\mu_g-\mu_b)r_\theta + k\beta^2(\mu_g-\mu_b)^2(1-2r)r_\theta\right]}{\beta(\mu_g-\mu_b)r_L + k\beta^2(\mu_g-\mu_b)^2(1-2r)r_L + k\beta^2\sigma_L^2} < 0,$$

$$L_\alpha^* = \frac{-k\beta^2\sigma_\alpha^2}{\beta(\mu_g-\mu_b)r_L + k\beta^2(\mu_g-\mu_b)^2(1-2r)r_L + k\beta^2\sigma_L^2} < 0.$$

To sign these two comparative statics, we assume that longer lockups hurt mimickers more than they hurt insiders of good firms. A longer lockup imposes two consequences on mimickers. First, longer lockups decrease the mean and, second, they can increase the information variance of the post-lockup payoff. An unfortunate artifact of mean-variance utility is that the prospect of a terrible outcome with high probability can be preferred to a distribution over good outcomes with high variance. To ensure that the additional consequences of a longer lockup decrease expected utility for mimickers, we assume that the loss due to the lower expected payoff is either reinforced or at least not reversed by the change in the variance. Formally, we assume

(4) $$-\beta(\mu_g-\mu_b)r_L - k\beta^2(\mu_g-\mu_b)^2(1-2r)r_L < 0.$$

The intuition of our first prediction, $L_\theta^* < 0$, is increasing transparency increases the probability that mimickers will get caught, allowing a separating equilibrium with shorter lockups. The intuition of our second prediction, $L_\alpha^* < 0$, is higher levels of firm-specific risk impose a higher lack of diversification cost on mimickers, again allowing for a separating equilibrium with shorter lockups. The three comparative statics regarding μ_b, C, and μ_g cannot be signed due to conflicting forces. Details of these three results are available from the authors.

III. Extant Evidence and Alternative Explanations

A. Alleged Evidence against Lockup Signaling

After introducing their informal signaling explanation for lockups, B&G (2003) test three assertions: firms with longer lockups should i) have a higher incidence of follow-on SEOs, ii) be more likely to initiate dividends, and iii) have a higher probability of positive price revisions during the pre-issue period. B&G find little evidence to support these assertions. Equipped with a formal model, we reexamine this alleged evidence against the signaling story.

Contrary to B&G (2003), a positive correlation between lockup length and follow-on SEO probability is not an implication of lockup signaling. Gale and Stiglitz (1989) show that for a new-issue signaling model to be valid, nature must have a chance to reveal the inside information before the second open-market period. In signaling theory, the lockup expiry satisfies the second period role. Thus, lockups replace follow-on SEOs in the model but do not predict them.

The source of B&G's (2003) prediction relating dividend initiation to lockup length is unclear—it may be driven by a belief that good firms pay dividends and bad firms do not.[4] However, signaling theory does not predict that firms with long lockups will initiate dividends. The difference between a good and bad firm in our model is that the good firm has a positive net present value project and the bad firm does not. If firms with good projects also need to fund good projects in the future, then an informal suggestion of our model would be that firms with long lockups are unlikely to initiate dividends. Thus, evidence of a negative correlation between long lockups and dividends does not contradict our formal signaling model and may even support it if good projects are serially correlated.

B&G (2003) claim that signaling theory implies that firms with long lockups should experience positive price revisions in the time period between the filing date of the prospectus and the offer date. However, insiders and their underwriters consider the length of the lockup and the quality of the project when they set the initial, pre-offer price range. Furthermore, lockup information is typically in the preliminary prospectus. That is, the lockup information is incorporated when the pre-offer price range is set and should be priced by investors when the lockup information is released, not in the weeks or months subsequent to the release.

It is tempting to look at stock returns for evidence either for or against our lockup signaling model. The temptation is rooted in the model's implication that firms with better projects will lock up for longer periods. However, good *projects* and good *firms* should not be confused with good *investments*. Signaling results in firms with good projects being fairly or efficiently priced—making the stock a fair investment, not a "good" investment. Thus, our signaling model does not predict price run-ups prior to the offer or long-run abnormal returns. To the contrary, since lockups allow for credible information to be conveyed to investors, signaling theory suggests that prices should be more efficient than otherwise.

B. Alleged Evidence for Commitment

B&G (2003) posit that lockups are commitment devices that alleviate a moral hazard problem. Clearly, lockups are commitment devices—the definition of a lockup is an agreement or *commitment* by insiders not to sell shares for a specified length of time. However, the definition of a lockup gives no insight into its purpose.

The term "moral hazard" typically refers to a hidden action subsequent to the contract. For example, after the offer, insiders could shirk, consume perquisites, engage in entrenchment activities, or avoid risky but profitable projects at the expense of outside investors who are unable to monitor insiders' behavior. In B&G's (2003) commitment explanation, "firm quality is observable ex ante" and "it is the level of asymmetric information regarding the actions of the managers in the aftermarket that is critical" (p. 5). Since lockups force managers who own shares to bear some of the burden of shirking and consumption, lockups reduce managerial incentives to undertake such actions. That is, a lockup acts as a temporary bond or commitment; thus, an outsider would be willing to pay more for a firm with longer lockups. Two shortcomings of this commitment explanation are: i) its

[4]B&G set a very high standard for their signaling story. In their version of signaling, firms with longer lockups must be more likely to both raise money from investors in a follow-on SEO and, at the same time, give money to investors through a dividend initiation.

predictions regarding transparency are indistinguishable from signaling's predictions, and ii) its plausibility is questionable given the relatively short lengths of observed lockup lengths.

With signaling, insiders know more about the quality of the firm at the time of the issue. With commitment, insiders know more about their own actions (effort) after the issue. Perhaps because of these differences, B&G (2003) note that, "The commitment hypothesis yields predictions that differ from the signaling alternative" (p. 5). But the predictions do not differ with respect to firm transparency; both commitment and signaling imply that opaque firms will have longer lockups. So, when B&G find that large firms and firms with underwriter or venture capitalist (VC) certification have shorter lockups, the finding is just as consistent with signaling as it is with bonding. Furthermore, our proxies for the degree of information asymmetry about firm value or the certification of firm value are not without precedent. Size and age have been associated with asymmetric information pertaining to firm value since Barry and Brown's (1984) and Ritter's (1984) studies. Underwriter prestige, auditor reputation, and VC backing have been associated with firm value certification since studies by Booth and Smith (1986), Titman and Trueman (1986), and Megginson and Weiss (1991).

The commitment story relies on lockups creating insider incentives that encourage hard work and a focus on value-enhancing activities; however, the incentives are temporary and the value impact of a few months' worth of increased managerial effort is likely to be immaterial. Additionally, managers could easily delay perks and work hard during the relatively short lockup period. Consequently, the need to monitor or bond insiders is long term. In contrast, the lockup period may be sufficient for firm quality to be revealed by nature and learning about the true quality of a firm's projects should have a material impact on the stock price.[5,6] If temporarily increased efforts by management due to the lockup have a small impact on value relative to the mitigation of the information asymmetry surrounding firm quality, one could argue that the transparency-related evidence in B&G (2003) is more supportive of a signaling than a bonding explanation for the existence of lockups.

IV. Data and Empirical Tests

A. Data

Our signaling model predicts that lockups will be shorter for transparent firms and firms with high idiosyncratic risk. We next discuss our data on lockups, transparency, and risk.

Our model assumes that the proceeds from the equity offer are used to fund new projects so we exclude issues where the primary use of funds is to pay down

[5]Field and Hanka (2001) find evidence in post-lockup sales data that is inconsistent with commitment. Rather than constraining inside managers, lockups appear to constrain selling by outside directors and venture capitalists, investors with relatively less day-to-day control over the company and therefore less need for commitment.

[6]A recent survey of 336 CFOs by Brau and Fawcett (2005) asks the question, "What type of signal do the following actions covey to investors regarding the value of a firm going public?" Over 77% of the CFOs agreed or strongly agreed that "Insiders commit to a long lockup" was a positive signal.

debt and issues where only secondary shares are sold. The main motive for issuing American Depository Receipts (ADRs) is often exposure to U.S. markets, not raising funds, so we also exclude ADRs. After incorporating these screens, we obtain data on 7,292 new issues (4,013 IPOs and 3,279 SEOs) from Securities Data Company (SDC) with offer dates between 1988 and 1999. Because we are interested in easy- and hard-to-value assets, we do not eliminate closed-end funds, units issues, or regulated firms.

We use three categories of transparency measures: i) firm-specific measures such as size, ii) industry classifications such as high-tech, and iii) third-party certification measures such as investment bank prestige. Large firms may be more transparent than small firms because large firms typically are followed by more analysts, are more likely to be in the news, have products or services used by more customers, and usually have a longer public history of performance. We use revenues as our proxy for firm size.[7] We use units (bundles of common stock and warrants) and IPOs as proxies for a lack of transparency.[8] Schultz (1993) associates issues of units with difficult-to-value growth opportunities. SEOs have a record of disclosures (e.g., earnings announcements, SEC filings, news stories, and analyst reports) that can increase firm transparency consistent with Ang and Brau (2002).

Our second group of transparency proxies is based on industries. The process of government regulation enhances firm transparency. We categorize regulated utilities using three-digit Standard Industrial Classification (SIC) codes of 481 (telecommunications) and 491–494 (electric, water, and gas distribution). Also, industries or companies whose assets are liquid securities minimize the potential for asymmetric information. We identify investment funds as any firm with a four-digit SIC code of 6726 or a firm categorized as a closed-end fund by either SDC or the Center for Security Prices (CRSP). In contrast, firms in the high-tech industry may have difficult-to-value assets (e.g., unique assets, projects in research and development, and new or unproven technologies). Following Field and Hanka (2001), we identify high-tech firms using three-digit SIC codes of 357, 367, 369, 382, 384, and 737.

The final group of transparency proxies consists of third-party certifiers. The underwriter certification hypothesis implies that firms selling new shares can certify their true value by hiring a prestigious investment bank—a bank with reputation-capital incentives to price the new issue as accurately as possible (e.g., Beatty and Ritter (1986)). In a similar fashion, the employment of a reputable auditor (e.g., Michaely and Shaw (1995)) or the involvement of VCs (e.g., Megginson and Weiss (1991)) can reduce the uncertainty surrounding the value of the firm. Similar to Hanley (1993), we proxy for underwriter reputation using market share, calculated with dollar volume, of new issues for each investment bank in

[7]We use the seasonally adjusted CPI-U (Consumer Price Index for All Urban Consumers, All Items) to convert all nominal dollar values to 1999 dollars. We use the SDC data for revenues first, then backfill with prior fiscal year-end Compustat data where available.

[8]We also use number of employees and age of the firm as proxies of transparency. Employees can serve as an alternative measure of firm size. Age can serve as a proxy for transparency since older firms with track records and established products have less information asymmetry than younger firms. In unreported tests (available from the authors), we find that the greater the number of employees and the older the firm, the shorter the lockup on average.

the prior year. Our data on Big 6 auditor and the involvement of VCs comes from the SDC database.

Our proxy for idiosyncratic risk is based on market model regressions. We regress daily stock returns for the 60 business days after the issue against daily returns on the CRSP value-weighted portfolio index. Our measure of idiosyncratic risk, MSE60, equals the mean square error of the market model regression for each firm. For clarity of reporting purposes, we multiply MSE60 by 100.

Table 1 reports summary statistics for our dependent variable, number of days in lockup, and explanatory variables measuring transparency and idiosyncratic risk. The first column reports on all 7,292 observations and the second and third columns report on IPOs and SEOs, respectively. The remaining columns divide the new issues into six groups: firms with exactly 0-, 1- to 89-, exactly 90-, 91- to 179-, exactly 180-, and over 180-day long lockups. Number of days in lockup has a mean of 164 days, a standard deviation of 165 days, and ranges from a low of 0 days to high of 1,825 days.

Preliminary support for our transparency prediction can be found in Table 1. SEOs, which tend to be more transparent than IPOs, have lockups that average only 103.7 days—about half as long as IPOs. Firms with lockups over 180 days tend to be small and tend not to be from the transparent fund and regulated industry groups. Furthermore, firms with the longest lockups are also less likely to have certification by a reputable investment bank, auditor, or VC.[9]

Our second prediction regarding firm-specific risk is not supported in Table 1. Firms with the longest lockups also have high measures of risk, MSE60. An explanation for this apparent inconsistency, supported in our subsequent multivariate testing, is that MSE60 simultaneously proxies for both risk and nontransparency in a univariate setting. However, in the following multivariate tests, after we control for transparency, MSE60 primarily proxies for risk and generally has the sign predicted by our model.

B. Multivariate Tests of the Number of Days in Lockup

We test our two predictions using a multivariate Tobit regression of the determinants of lockup length.[10] The reduced-form model we estimate is

$$L_i = \pi_0 + \pi_1\theta_i + \pi_2(100 * \text{MSE60}_i) + \varepsilon_i, \tag{5}$$

where i denotes the ith issuing firm, L is the number of days in lockup, π_0 and π_2 are coefficients and π_1 is a vector of transparency coefficients, θ is a vector of transparency variables, MSE60 is the measure of idiosyncratic risk, and ε is a random error term.

[9]In unreported tests, when univariate parametric (non-parametric) difference of means (medians) tests are conducted on each of the transparency conditioning variables, differences are statistically significant beyond the 0.0001 level, in the predicted direction, for all variables using parametric tests (for all variables except high-tech using non-parametric tests).

[10]Our model differs from B&G (Table 2) in that we include SEOs and issues with no (zero-day) lockups because we are concerned with explaining the existence and length of all lockups, not just the length of IPO lockups. We use a Tobit specification, rather than OLS, because our dependent variable (number of days in lockup) is censored on the left tail at zero. Given our model's two predictions, we include transparency proxies such as SEOs, units, industry designations, and a risk measure and, given potential endogeneity problems, we exclude variables such as the percent of primary shares.

TABLE 1

Summary Statistics for a Sample of Firmly Underwritten Equity Issues by Issue Type and Length of Lockup (1988–1999)

	Issue Type			Days in Lockup					
	Full Sample	IPO	SEO	0	1–89	90	91–179	180	> 180
Sample Size of Group	7,292	4,013	3,279	1,507	118	1,444	526	2,592	1,105
Panel A. Dependent Variable									
No. of days in lockup	163.6	212.6	103.7	0	48.4	90	124.4	180	475.7
	(165.2)	(187.3)	(105.8)	(0.0)	(17.5)	(0.0)	(11.2)	(0.0)	(190.2)
Panel B. Explanatory Variables									
Firm Transparency Variables									
Revenues ($ mill.)	350	143	554	1,252	405	414	159	150	36
	(2,509)	(1,485)	(3,203)	(5,744)	(910)	(2,038)	(411)	(1,321)	(195)
Units	10%	13%	5%	11%	1%	2%	1%	2%	40%
	(29%)	(34%)	(22%)	(31%)	(9%)	(14%)	(9%)	(14%)	(49%)
IPO indicator	55%	100%	0%	48%	6%	11%	29%	79%	84%
	(50%)	(0%)	(0%)	(50%)	(24%)	(31%)	(45%)	(41%)	(36%)
Industry Transparency Variables									
Investment fund	8.2%	11.9%	3.7%	34.2%	0.0%	0.5%	0.6%	2.7%	0.2%
	(27%)	(32%)	(19%)	(47%)	(0%)	(7%)	(8%)	(16%)	(4%)
Regulated utility	4%	3%	6%	7%	6%	4%	3%	4%	2%
	(20%)	(17%)	(23%)	(26%)	(24%)	(18%)	(16%)	(19%)	(15%)
High-tech	25%	28%	20%	7%	37%	27%	27%	33%	24%
	(43%)	(45%)	(40%)	(26%)	(49%)	(45%)	(45%)	(47%)	(43%)
Third-Party Certification Variables									
Investment bank prestige	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.01
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.03)
Big 6 auditor	87%	84%	91%	87%	95%	93%	92%	93%	63%
	(33%)	(37%)	(29%)	(33%)	(23%)	(25%)	(28%)	(25%)	(48%)
VC backing (IPO only)	32%	32%	na	6%	14%	29%	58%	47%	16%
	(47%)	(47%)	na	(23%)	(38%)	(46%)	(49%)	(50%)	(37%)
Idiosyncratic Risk Variable									
MSE60∗100	0.17	0.20	0.14	0.10	0.12	0.14	0.12	0.22	0.23
	(0.30)	(0.26)	(0.33)	(0.47)	(0.17)	(0.15)	(0.12)	(0.26)	(0.28)

Table 1's entries are the mean followed by standard deviation in parentheses below. Data are obtained from the Securities Data Company's New Issues database, Compustat, and CRSP and represent levels prior to the offer date. Non-ADR IPOs and SEOs with primary shares and proceeds not used for debt reduction are included. SIC codes of 481 (telecommunications) and 491–494 (electric and gas distribution) indicate regulated utility, SIC code 6726 indicates investment fund, and SIC codes 357, 367, 382, 384, and 737 indicate high-tech. Investment bank prestige is measured as the market share of the lead underwriter in the previous year. MSE60 is the mean squared error of a market model regression over the 60 days after the issue.

The two predictions of our model are: $\pi_1 < 0$ and $\pi_2 < 0$. Because of non-normalities, we use the log of revenues as our measure of size. Due to non-simultaneous missing independent variables, our base regression model consists of 5,018 firms (2,463 IPOs and 2,555 SEOs).

The results of estimating equation (5) are reported in Table 2; they support our model's two predictions. For each unit increase in the log of revenues, the length of the lockup decreases by 12.8 days on average (p-value less than 0.0001). Units have lockups that are typically 138.6 days longer than straight new equity issues. IPOs typically lock up for 123.0 days longer than SEOs. Both the units and IPO coefficients are significant (p-values less than 0.0001).

Easy-to-value investment funds and regulated utilities have significantly shorter lockup periods than firms in other industries. Coefficients on the investment fund and regulated utility binary variables indicate 174.6-day (p-value less than 0.0001) and 28.7-day (p-value = 0.0060) shorter lockups on average, respectively. The high-tech coefficient, contrary to our prediction, is not significant.

TABLE 2

Tobit Regression of Number of Days in Lockup for Equity Issues (1988–1999)

$$L_i = \pi_0 + \pi_1\theta_i + \pi_2(100 * \text{MSE60}_i) + \varepsilon_i$$

Independent Variable	Predicted Sign	Estimated Coefficient	*p*-Value
Intercept		203.6	< 0.0001
Log of revenues	–	–12.8	< 0.0001
Units	+	138.6	< 0.0001
IPO indicator	+	123.0	< 0.0001
Investment fund	–	–174.6	< 0.0001
Regulated utility	–	–28.7	0.0060
High-tech	+	–1.6	0.7399
Investment bank prestige	–	–155.0	< 0.0001
Big 6 auditor	–	–58.7	< 0.0001
VC∗IPO	–	–39.9	< 0.0001
MSE60∗100	–	–12.1	0.0954

See notes to Table 1 for variable definitions and sample description. In the Tobit model, i denotes the ith firm, L is the number of days in lockup, π_0 and π_2 are coefficients, π_1 is a vector of transparency coefficients, θ is a vector of transparency variables, MSE60 is a measure of idiosyncratic risk, and ε is a random error term.

When an investment banker's market share increases by one, the number of days in lockup drops by 155 days on average (i.e., 1.5-day decrease per 1% increase in investment bank market share; *p*-value less than 0.0001). Furthermore, certification by a Big 6 auditor reduces the length of the lockup by 58.7 days (*p*-value less than 0.0001). If an IPO has VC certification, its lockup is reduced by 39.9 days on average.

The coefficient, -12.1 days, on MSE60 lends support to our model's second prediction: higher idiosyncratic risk leads to shorter lockups. The coefficient, however, is only marginally significant (*p*-value = 0.0954). This weak result may not be surprising given the difficulty in estimating idiosyncratic risk while separating it from firm transparency.

In unreported tests (available upon request), we re-estimate equation (5) using alternative samples and proxies. We re-estimate the regression for IPOs and SEOs separately, after excluding zero-day and 180-day lockups for sub-periods, after including industry dummy variables, and after measuring risk using the sum of squared errors from the market model. In general, the results of Table 2 are robust although, as expected, when the sample size is small we observe some loss of significance. The two exceptions to this general finding of robustness are the coefficients for the high-tech and MSE60 variables.

Endogenously determined alternative signals, such as Leland and Pyle's (1977) share retention and Welch's (1989) underpricing, cannot be included as independent variables in regressions explaining lockup length because of their correlation with the error term. That is, our coefficients from estimating (5), π_1 and π_2, include direct effects of θ and α on L and indirect effects. Intuitively, as transparency decreases our model shows that lockups may be used intensively; this is the direct effect. If other signals substitute for lockups, their increased application may indirectly reduce the length of lockups.[11] To check the robustness

[11]A system of three equations (one each for the lockup length, the degree of underpricing, and the proportion of secondary shares sold at the new issue) cannot be estimated due to a lack of independent instrumental variables.

of the direct effects, we re-estimate (5) for different levels of underpricing and secondary shares.

When we estimate (5) for three different levels of underpricing, the results are qualitatively similar with the results of Table 2. The one exception is that MSE60 is only negative and significant in the third of the firms with the greatest degree of underpricing. When we estimate (5) only using firms that did not sell secondary shares, a data set that closely mirrors our theoretical model, none of the independent variables' signs change and none lose their significance. When we estimate (5) using firms that only sell secondary shares (i.e., no primary shares included in the offering), all of the previously significant coefficients remain significant and the high-tech coefficient becomes positive as predicted. Overall, our robustness tests suggest that the evidence supporting our predictions regarding transparency (with the exception of high-tech) is very strong and robust. In contrast, the evidence supporting our risk prediction is weak and not robust, perhaps due to MSE60's dual role as a measure of both idiosyncratic risk and nontransparency.

V. Summary and Conclusion

Brav and Gompers (2003) (B&G) suggest several explanations for IPO lockups. They find support for their commitment explanation (lockups solve a post-issue moral hazard problem) and promote evidence against their signaling explanation (lockups solve a pre-issue adverse selection problem). We extend B&G's work in four dimensions.

First, we turn the signaling story into a formal theory. The lockup forces insiders to not only *put* their money where their mouth is but to *keep* it there as well. Sending a false lockup signal is costly since insiders must spend money on negative net present value projects in order to keep up appearances and must bear idiosyncratic risk; yet nature may reveal the true value of the firm before the insiders can sell their shares at the end of the lockup. Second, using the signaling model, we reevaluate the alleged evidence against lockup signaling. We show how B&G's (2003) arguments based on follow-on SEOs, dividend initiations, and price revisions do not constitute evidence against lockup signaling theory. Third, we show that B&G's evidence of an inverse relationship between transparency and lockup length supports the signaling model at least as much as the commitment explanation. Fourth, we test two explicitly derived comparative statics from our model: longer lockups are associated with a greater need for signaling (high information asymmetries) and a lower cost of sending a false signal (low idiosyncratic risk). We find empirical support for both predictions although the evidence for the second prediction is weak.

We conclude with a summary of our paper's thesis: the lockup signaling theory continues to possess both theoretical and empirical merit. B&G (2003) attempt to dismiss the signaling theory as an explanation for the existence of lockups. We argue that this dismissal is at best premature.

Appendix

For given β and L, the mean and variance of the post-lockup payoff to insiders in a bad firm are derived as follows. If nature reveals the truth (which happens with probability r), then the value of a bad firm is μ_b; whereas, if nature is silent then the value of a bad firm is μ_g. Since insiders retain a fraction β of the firm, their mean payoff is $r\beta\mu_b + (1-r)\beta\mu_g$. The associated variance is

$$\begin{aligned} & r[\beta\mu_b - (r\beta\mu_b + (1-r)\beta\mu_g)]^2 + (1-r)[\beta\mu_g - (r\beta\mu_b + (1-r)\beta\mu_g)]^2 \\ = \quad & r\beta^2[(1-r)\mu_b - (1-r)\mu_g]^2 + (1-r)\beta^2[r\mu_g - r\mu_b]^2 \\ = \quad & \beta^2(\mu_g - \mu_b)^2[(1-r)^2 r + (1-r)r^2] \\ = \quad & \beta^2(\mu_g - \mu_b)^2(r - r^2). \end{aligned}$$

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