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Moral hazard, asymmetric information and IPO lockups

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ABSTRACT

Moral hazard and asymmetric information have both been proposed as the motive behind the use of IPO lockup provisions, with each receiving empirical support in the literature. Rather than consider them to be mutually exclusive motivations, we hypothesize that each is dominant for a different set of firms. We provide novel empirical support for the underwriter certification hypothesis then use this hypothesis to categorize the firms in our sample. Firms that are certified by a reputable underwriter see a reduction in the severity of asymmetric information relative to other firms and therefore will be more likely to see moral hazard as the friction that motivates the use of the lockup provision. For those firms that are unable to obtain high reputation underwriter certification it is relatively more likely that asymmetric information is the motivation for the use of the lockup provision. Based on this separation of firms we introduce and provide empirical support for a novel set of hypotheses concerning the lockup period.

1. Introduction

Recently, considerable attention has been paid to understanding the lockup provision embedded in the contract between an underwriter and a firm engaged in its initial public offering of equity. This literature examines motivations for the lockup provision, the determinants of the length of the lockup period, and the returns around lockup expiration. Brav and Gompers (2003) and Brau et al. (2005) both examine the motivation for the use of the lockup provision and the determinants of the lockup length and come to opposing conclusions with the former reporting support for the hypothesis that the lockup provision is used to control moral hazard and the latter reporting support for the hypothesis that lockups are used to control adverse selection. Here, we re-examine this issue and offer a resolution for the apparent conflict.

We posit that all firms suffer from both moral hazard and adverse selection problems. For some, moral hazard will be the dominant consideration in including the lockup provision in the IPO contract and in determining the lockup length, while asymmetric information will dominate for others. Based on this hypothesis and the idea that the signal produced by the choice of lockup period is not perfectly revealing we develop a set of testable predictions concerning the length of the lockup period. Underpricing, a central issue in the IPO literature, plays a major role in our analysis. Underpricing is a particularly useful diagnostic in this environment because it is affected by information asymmetry but not by post-issue commitment problems.[2] In such an environment, the empirical regularities seen in the full sample (for an "average" firm) do not accurately reflect the behavior of

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[2] IPO underpricing is caused by asymmetric information in several canonical models, e.g. Benveniste and Spindt (1989) and Rock (1986). We are not aware of a model in which underpricing is caused by ex-post commitment problems of insiders. Likewise, surveys such as Jenkinson and Ljungqvist (2001) and Ibbotson et al. (1994) do not entertain the notion that underpricing could be caused by ex-post managerial agency problems. Given that underpricing is resolved extremely rapidly, it is difficult to imagine how it could serve to control moral hazard.

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firms for which asymmetric information is the dominant consideration in determining the lockup length nor the behavior of firms for which moral hazard is the dominant friction.

We separate our sample based on whether asymmetric information (the asymmetric information subsample) or moral hazard (the moral hazard subsample) is most likely to motivate the use and determine the length of the lockup. This sample bifurcation is the basis of our research design, and it leads to differential predictions on the co-movements of key variables. For example, consider a firm that suffers from both moral hazard and asymmetric information problems but for which moral hazard is the determinant of the lockup length. Because asymmetric information is present, the IPO is expected to exhibit underpricing. However, consider a hypothetical shock that increases the level of information asymmetry while leaving the severity of moral hazard unchanged. Such a shock will increase underpricing but not the lockup length for this firm. Conversely, consider a hypothetical shock increasing the severity of moral hazard while leaving information asymmetry unchanged. Such a shock increases the lockup length but not underpricing. In either case, lockup length and underpricing should not co-vary in a cross section of such firms.

Suppose instead that information asymmetry is the dominant consideration when choosing the lockup length. The effect of increasing the level of information asymmetry will be to increase both underpricing and the length of the lockup. A shock increasing the severity of the moral hazard problem, however, should not affect underpricing or the lockup length. We therefore predict that lockup length and underpricing exhibit a positive correlation in the information asymmetry sample.

When the lockup is chosen to control a moral hazard problem, it will be chosen recognizing the personal cost to insiders of a poorly diversified position. A given level of control of the managerial moral hazard problem can be achieved with a combination of post-IPO shares and a given lockup. In order to maintain a constant level of control of the moral hazard problem, at the margin, an increase in the post-IPO ownership by insiders allows a reduction in the length of the lockup. The post-IPO level of ownership will not, however, have a first order impact on the nature of the pre-IPO asymmetric information problem. Therefore the level of insider ownership and the length of the lockup should be negatively correlated in the cross section of moral hazard firms and uncorrelated in the sample of asymmetric information firms.

Our empirical tests require an identification strategy by which firms may be separated based on which of the frictions, moral hazard or asymmetric information, is likely to be the dominant consideration for the length of the lockup provision. One such candidate proxy is firm size. As a firm grows, its assets are likely to become more transparent and easier to value, which in turn should reduce the severity of information asymmetry (Beatty and Ritter (1986)). By contrast, firm size need not diminish agency problems. In particular, managerial misconduct and/or shirking occur at both large and small firms. Consequently we expect the relative magnitude of these two frictions to vary with firm size.

Our second proxy is the reputation of the underwriter. As argued by Beatty and Ritter (1986) (and supported empirically in Carter and Manaster (1990)) certification by a high reputation underwriter reduces the severity of information asymmetry. On the other hand, the analogous argument regarding agency problems is on much thinner ground. In particular, while investment banks can certify the value of an asset, they cannot certify (or prescribe) managers' future actions. In fact, without retained (and locked) equity as a costly signal, insiders themselves have difficulty making credible promises regarding their *own* actions. It is less plausible still that such a commitment could be delegated to a third party not involved in running the firm. Hence, ceteris paribus, underwriter certification should reduce the severity of information asymmetry relative to that of commitment problems. Therefore it should be more likely that the dominant concern for firms taken public by high reputation underwriters is moral hazard. Conversely, it should be more likely that asymmetric information is the determining friction for the lockup provision in firms taken public by low reputation underwriters.

We empirically verify the relation between both proxies and the level of asymmetric information by examining lockup expiration returns. Expiration returns allow us to consider the severity of asymmetric information at the precise moment when managers' trades reveal the quality of their information. More dispersion in post-lockup returns suggests more dispersion in private information.[3] Our results are consistent with this view. Larger IPOs and those backed by reputable underwriters are associated with significantly smaller dispersion in returns at the expiration of the lockup.

Empirically, the bifurcated samples behave as hypothesized. In the asymmetric information subsamples (small firms and those taken public by low reputation underwriters) we find that lockup length co-varies positively with underpricing. While in the moral hazard subsamples lockup length is uncorrelated with underpricing. We also document the hypothesized different co-movements between the lockup length and post-IPO insider ownership across the two subsamples. The correlation between lockup length and insider ownership is negative in the moral hazard subsamples and zero in the asymmetric information subsamples.

Two recent papers are closely related to our analysis. Brav and Gompers (2003) examine three motives for the existence of the lockup provision, asymmetric information (signaling), moral hazard (commitment), and rent extraction on the part of issuers. They find no support for the rent extraction hypothesis and interpret their evidence as suggesting that lockups function primarily as a commitment device to alleviate moral hazard problems between managers and new shareholders. Arguing that the variables used by Brav and Gompers (2003) to measure moral hazard are more naturally interpreted as indicating the severity of an asymmetric information problem, Brau et al. (2005) (BLM) instead favor the hypothesis that lockups serve as a signal of quality.

[3] See also Lowry, Officer and Schwert (2006), Wang and Yung (in press) and Yung et al. (2008) who also identify cross-sectional dispersion in returns with asymmetric information.

They develop a signaling model and provide empirical support for its predictions. Their model, however, does not consider moral hazard.

A common feature of Brav and Gompers (2003) and Brau et al. (2005) is that their analyses consider that the signaling hypothesis and the commitment (or moral hazard) hypothesis are mutually exclusive. An alternative interpretation is that these papers seek to determine which of these frictions determines the lockup length for the "average" firm in the universe of firms that have gone public. Brav and Gompers (2003) and BLM (2005) also both use the intuition of a separating signaling equilibrium to generate their empirical predictions concerning the signaling hypothesis. This is a somewhat limiting perspective because if the equilibrium is separating then asymmetric information cannot be a determinant of any underpricing at the time of the IPO. Consequently, their analyses almost entirely ignore underpricing.

Reconciling these conflicting results, our analysis highlights the importance of Brav and Gompers' (2003) argument in the moral hazard subsample and BLM's (2005) argument in the asymmetric information subsample. In particular, the aforementioned co-movements emphasized in this paper (lockup length and underpricing; lockup length and insider holdings) differ between the two subsamples. These differences are obscured in the full sample, which emphasizes the importance of considering the motivations for the lockup provision separately.

The paper is organized as follows. Section 2 develops our empirical hypotheses. Section 3 describes the data and Section 4 presents our results. Section 5 concludes.

2. Hypothesis development

2.1. The role of asymmetric information

Firms issuing public equity face a variety of constraints imposed by asymmetric information regarding the value of assets-in-place and growth options. If the market is characterized by heterogeneously informed investors, then offer prices must be discounted on average, either in order to compensate uniformed investors for the winner's curse (Rock, 1986) or to persuade informed investors to reveal their information (Benveniste and Spindt, 1989). Compounding the problem, even if issues were fairly priced on average, high-quality firms would still suffer mispricing losses because they are pooled with lower quality firms.

Given the disclosure and reporting requirements associated with public equity, information concerning firm quality is revealed over time. Strategic trading by speculators in the secondary market may hasten this process, however, asymmetric information and the subsequent revelation of information in the aftermarket allow a role for the lockup of insider's shares as a signaling device. Insiders in high-quality firms would prefer to lock shares, committing to sell them only after (it becomes highly probable that) information has been revealed, in order to avoid being pooled with (at least some of) the low-quality firms.

Of course, lockups impose personal costs on firm insiders in the form of poor diversification. Insiders in high-quality firms will therefore choose lockups of intermediate rather than extreme length, balancing the inherent trade-off. Insiders in low-quality firms, while preferring to avoid locking their shares, must choose between mimicking this choice and having their quality truthfully revealed. Heterogeneity within the set of low-quality firms results in a pooling equilibrium in which high-quality firms select a lockup period long enough to prevent some but not all low-quality firms from mimicking. An important consequence of this is that there will be underpricing at the IPO despite the signaling efforts of high-quality firms.[4]

Consider a firm for which the asymmetric information problem is the determinant of the lockup length. When the lockup length is used as a signal of firm quality, an increase in the asymmetry of information magnifies the benefits of the lockup but not the cost faced by the insiders. Consequently, we should observe longer lockups. As discussed above, heightened information asymmetry also causes greater underpricing. We therefore hypothesize the following:

H1a. Controlling for other determinants of lockup length, in a sample of firms for which the lockup length is driven by asymmetric information the lockup length should positively co-vary with underpricing.

2.2. The role of moral hazard

In addition to their role in signaling quality, lockups may serve as a commitment device to alleviate moral hazard problems concerning actions taken by managers after the firm has gone public. By requiring the insiders to hold shares for a period of time after the IPO and so facing them with the financial consequences of their choices, the lockup provision helps to align the interests of the insiders with those of the other shareholders. Such a paradigm alters the argument leading to Hypothesis 1a.

Consider a firm for which the moral hazard problem is the determinant of the lockup length. In this case, we argue that lockup length and underpricing will not co-vary. An increase in the amount of asymmetric information increases the level of underpricing,

[4] Some authors have considered underpricing itself as a signal (see Allen and Faulhaber (1989), Welch (1989), and Grinblatt and Hwang (1989)). We do not consider this signal for several reasons. First, the empirical findings seem to unanimously reject the predictions of signaling-via-underpricing (see for example Michaely and Shaw (1994), Jegadeesh et al. (1993), Garfinkel (1993), Spiess and Pettway (1997), and Jain and Kini (1994) and surveys by Ritter and Welch (2002) and Jenkinson and Ljungqvist (2001). Secondly as emphasized by Ritter and Welch (2002) and Jenkinson and Ljungqvist (2001) it is not clear that using underpricing as a signal is the most efficient way to convey information credibly to the market. Finally, underpricing is not a choice variable for the firm. Rather, the relevant choice variable is offer price. Even if the firm could identify the expected aftermarket price correctly, the uncertainty around this variable would cloud any signaling content of underpricing itself.

but will not increase the length of the lockup. Similarly, in this case, an increase in the severity of the moral hazard problem will increase the lockup length but not underpricing. Together this lack of co-movements implies the following hypothesis.

H1b. In a sample of firms for which the lockup length is driven by moral hazard the lockup length should be uncorrelated with underpricing.

Intuitively, asymmetric information influences underpricing in all IPOs while it affects the lockup length only for firms that see asymmetric information as the friction that determines the length of the lockup period at the margin.

H2. For all firms, the level of asymmetric information should be a determinant of underpricing. In the set of firms for which the lockup length is determined by asymmetric information, the level of asymmetric information should be a determinant of the length of the lockup period. In contrast, for the sample of firms for which the lockup length is driven by moral hazard, asymmetric information should not be a determinant of the length of the lockup period.

Hypothesis H2 is derived by looking at the economic mechanism behind the covariance structure highlighted in Hypotheses 1a and 1b and so represents a stronger test of the relations between lockup length and firm characteristics discussed above.

Finally, for a more in depth examination of the moral hazard motive for the length of the lockup period, consider the effect, all else equal, of a change in the amount of equity retained by managers. For the moral hazard firms, the level of the manager's post-IPO holdings is a primary determinant of the severity of the managerial moral hazard problem. As the post-IPO shares retained by management increases, solving the managerial moral hazard problem requires a shorter lockup period, generating a negative relation between retained shares and lockup length within this set of firms. For the adverse selection firms, the prediction is less obvious. As the level of post-IPO ownership falls, there is no direct effect on the asymmetric information problem and so no direct effect on the length of the lockup. However, a possible second order effect is that as post-IPO ownership falls, there may be less of an incentive for managers of bad firms to mimic good firms. This would translate to a reduction in the length of the lockup used by asymmetric information firms. This discussion generates the following hypothesis:

H3. In a sample of firms for which the lockup length is driven by moral hazard, controlling for other factors explaining lockup length, there should be a negative correlation between lockup length and the amount of equity retained by managers. For those firms for which the lockup length is driven by asymmetric information there should be a nonnegative correlation between the length of the lockup and the amount of equity retained by the manager.

2.3. The role of certification

As discussed above, testing these hypotheses requires that we separate the moral hazard firms (firms for which the moral hazard problem dominates the asymmetric information problem) and the asymmetric information firms (firms for which the asymmetric information problem is the dominant friction). In the literature three characteristics of IPO firms have been shown to serve a certification role: whether the IPO firm had venture capital financing prior to the IPO, whether the IPO firm is taken public by a high reputation underwriter, and firm size.

Beatty and Ritter (1986) and Carter and Manaster (1990) argue that high-quality underwriters act to reduce the uncertainty concerning the value of the firms they take public. These underwriters, due to the frequency of their participation in the IPO market, have a strong incentive to develop and maintain their reputations and so are said to perform more extensive due diligence and more accurately convey the resulting information to the market relative to low-quality underwriters. Hence, this certification process is argued to reduce the information asymmetry problem.

By contrast, the process of certifying the value of an asset has no impact on the severity of the managerial moral hazard problem. In particular, the "commitment problem" emphasized by Brav and Gompers (2003) concerns the ability (or lack thereof) of insiders to make promises regarding their own ex-post actions. Claims from the underwriter regarding managements' ex-post actions would be even less meaningful. Underwriters simply cannot influence managers' future actions to the same extent that retained (and locked) equity does.

Because of these differential effects, certified firms should therefore be more likely to have lockup periods determined by an attempt to control managerial moral hazard. Those firms without the certification provided by high-quality underwriters are subject to a more acute problem of asymmetric information and should, therefore, be more likely to have lockup periods determined by asymmetric information.

Megginson and Weiss (1991) make a similar argument concerning the certification role of venture capitalists (VCs). Venture capitalists are repeat players in the IPO market as it represents an important "exit strategy" from their investments. VCs, therefore, also have an interest in maintaining reputations and serving as a screening mechanism.

Finally, firm size should play a role similar to that of underwriter certification. As previously noted, assets tend to become more transparent and thus easier to value as a firm grows (Beatty and Ritter (1986)). The net effect is to reduce the potential scope of private information. The analogous argument for agency problems is less plausible. Managers of large firms are just as capable of stealing or shirking as their small firm counterparts. Consequently, we expect the relative importance of information asymmetry to decrease as firms get larger. This proxy is not likely to be as powerful an indicator of firm type (moral hazard or asymmetric information) as is underwriter reputation; however, firm size is not jointly chosen along with other aspects of the IPO (as

underwriter reputation may be argued to be) and so it is not subject to concerns of endogeneity. We empirically examine the certification role of high-quality underwriters and VCs, and the screening effect of firm size in Section 4.

3. Data

The data for this study was drawn from the Thompson SDC data base and consists of initial public offerings of equity for the period 1988 through 2006. Information was collected for each IPO concerning the proceeds of the offer, the identity of the lead underwriter(s), the length of the lockup period, the number of primary and secondary shares offered, the percentage of post-IPO shares owned by insiders, the number of post-IPO shares outstanding, and whether the offering was VC-backed or from the high-tech industry. Information on underwriter rankings (based on Carter and Manaster (1990)) was gathered from Jay Ritter's[5] website. Jay Ritter also generously provided us with a list of corrections to SDC's VC-backing dummy.

For comparability with earlier studies, we restrict this sample by eliminating several special classes of initial public offerings: ADRs, units, closed-end funds, REITs, limited partnerships, reverse LBOs and equity-carve outs. We note occasional discrepancies between SDC and CRSP regarding these characteristics. For example, some new issues defined by CRSP as REITs (share code 18) or as closed-end funds (share code 14) are not flagged as such by SDC. Cross-referencing these observations with the SEC's online EDGAR database reveals that the CRSP designation is typically correct. Therefore, we exclude an IPO from our sample if it is classified by *either* SDC or CRSP as one of the aforementioned special cases. Our entire sample therefore consists of ordinary common shares (CRSP share codes 10 or 11).

Alon Brav and Paul Gompers kindly shared their corrections to the lockup lengths reported on SDC. After substituting these values for the incorrect (or in some cases missing) values in SDC's database, we have 4025 IPOs with known lockup lengths.

Recently SDC has begun listing multiple lockup lengths for some IPOs, and this convention is becoming more frequent, especially after 2004. In cases of multiple lockups, SDC employs the codes "company lockup" (the most common designation), "selling shareholder lockup" or "management lockup." The last of these three codes most accurately reflects the spirit we wish to capture. Unfortunately this code is not always present, as SDC appears to use the code "company lockup" somewhat generically for many observations.

We convert these multiple values to a single variable using the following algorithm. When multiple lockup lengths are reported, of which exactly one is listed as a management lockup, we use the unique value listed for "management lockup." In the case of multiple management lockups (only a few cases) we use the average of these values. In the event that none of the lockups are designated "management lockup" we use the average of all "company lockups"; that is, our algorithm places first priority on "management lockup" and second priority on "company lockup." There were no observations in which both of these designations were absent, and so we do not employ "selling shareholder" lockups in our analysis.[6]

We modify the SDC data in two additional ways. Ljungqvist[7] finds that the number of post-IPO shares reported by SDC is correct only 23.6% of the time; the average error (SDC/truth − 1) is 14.9% and the median error is 0%. Loughran and Ritter (2004) find that CRSP is a much more reliable source of post-issue shares outstanding for IPOs with only one share class. We therefore incorporate the CRSP value for single share class IPOs and retain the value from SDC otherwise. Finally, the first day return is occasionally missing in SDC. We backfill some of the missing values by extracting the first closing price reported by CRSP. We backfill in this way only if the first reported trade is no more than seven days following the IPO; in most cases there is no lag.

As a final check on the reliability of SDC data, we investigate the lockup length reported by SDC by reading the prospectuses for a random sample of 100 IPOs taking place between 1997 and 2006 (the period of our analysis not covered by Brav and Gompers' hand-collected values). In at least ninety-five cases these observations are correct. Some of the remaining cases involve ambiguity. For example, the prospectus occasionally reveals that insiders are subject to differential lockup lengths, though SDC reports a unique value (corresponding to one of these numbers). Overall, we conclude that the error rate appears to be very low and so do not pursue this issue further.[8]

Table 1, presents the descriptive statistics for our full sample (panel A) and for subsamples based on underwriter reputation (panel B) and venture capital backing (panel C). IPO proceeds have been converted to January 2000 values using the GDP deflator time series data available from the website of the St. Louis Federal Reserve. The size of the offering and the dollar value of insiders' holdings are both highly skewed variables. In all of our tests, we therefore replace dollar-denominated figures with logarithmic values. Overall the summary statistics show our sample is very consistent with other samples examined in the literature.

Panels B and C of Table 1 illustrate significant differences across subsamples. VC-Backed IPOs occur more frequently in high-tech industries, and reputable underwriters are associated with larger IPOs. Also, the average lockup length is much shorter for IPOs backed by either a venture capitalist (190.9 days) or a reputable underwriter (180.1 days) than for IPOs with neither type of backing (279.6 days). While these lower averages are consistent with a reduction in the severity of market imperfections, it is unclear whether this pattern reflects a reduction in asymmetric information or in moral hazard.

In the full sample (panel A), the lockup length has a mode and median of 180 days, indicating significant clustering at this length. There is moderate dispersion ($\sigma = 130.5$ days) and significant clustering on other multiples of 90 as well as on multiples of

[5] See http://bear.cba.ufl.edu/ritter/ipodata.htm.

[6] We experimented with some other natural algorithms, including the average of all lockups listed and the maximum of all lockups listed. None of these change our results in any significant way, because the number of observations with multiple lockups is relatively small. Moreover, this SDC convention begins precisely at the time when the lockup length becomes more standardized.

[7] See http://pages.stern.nyu.edu/~aljungqv/research.htm.

[8] Field and Hanka (2001) perform a similar reliability check in an earlier period (1988–1992), concluding that the error rate in this variable is approximately 3%.

Table 1
Summary statistics. The sample includes 4025 IPOs between 1988 and 2006. Insider holdings is the dollar value of insider holdings at the end of the first day of trading, divided by the total market value of the firm's equity at the end of the first day of trading. Venture capital backing and High-Tech Industry are dummy variables defined by SDC if the issuer is backed by a venture capitalist or in a high- tech industry. Underpricing is the difference between the first closing price and the offer price, divided by the offer price. Reputation is the Carter–Manaster ranking of the lead underwriter (or in the cases of multiple lead underwriters, the average ranking). Real proceeds are the total amount raised in the offering, expressed in January 2000 dollars using the GDP deflator.

	Mean	Median	Std deviation
Panel A: Full sample (N = 4025)			
No. of primary shares	3,575,049	2,300,000	4,942,280
No. of secondary shares	1,811,477	636,000	7,117,217
Percentage insider holdings	0.430	0.447	0.213
Days of lockup	218.9	180.0	130.5
Venture capital backing	0.399	0.000	0.490
High-tech industry	0.470	0.000	0.499
Underpricing	0.169	0.091	0.363
Reputation	7.00	8.00	2.23
Real proceeds ($M)	61.00	34.02	131.90
Panel B: IPOs with reputable underwriters (N = 2827)			
No. of primary shares	4,161,583	2,800,000	5,474,873
No. of secondary shares	2,052,113	744,000	7,783,302
Percentage insider holdings	0.425	0.445	0.218
Days of lockup	187.0	180.0	68.4
Venture capital backing	0.470	0.000	0.499
High-tech industry	0.510	1.000	0.500
Underpricing	0.183	0.100	0.388
Reputation	8.27	8.00	0.69
Real proceeds ($M)	77.03	43.36	152.67
Panel C: Venture capital backed IPOs (N = 1607)			
No. of primary shares	3,047,971	2,500,000	2,393,344
No. of secondary shares	860,564	600,000	1,168,110
Percentage insider holdings	0.410	0.420	0.188
Days of lockup	190.1	180.0	74.6
Venture capital backing	1.000	1.000	0.000
High-tech industry	0.721	1.000	0.449
Underpricing	0.211	0.114	0.407
Reputation	7.63	8.00	1.69
Real proceeds ($M)	44.62	35.24	38.60

365. A fact which has significant bearing on our subsequent analysis—and is not identified by the previous literature to our knowledge—is that the presence of either a high-quality bank or a venture capitalist is associated with much lower *dispersion* in the lockup length. This lower dispersion is especially dramatic for high-quality investment banks, which are associated with very strong clustering on 180 days. In fact, only 15.2% of IPOs underwritten by high-quality banks have a lockup length other than 180 days. Field and Hanka (2001) observe an increasing standardization at the 180 day lockup period in their sample of IPOs from 1988 to 1997. As Table 2 shows, this pattern continues (and indeed intensifies) after 1997.

As a preliminary investigation of this standardization, we consider whether firm characteristics have changed over time in ways that might explain the increased standardization. Specifically, noting that Table 1 shows that different types of IPOs are

Table 2
Distribution of lockup length across time. The sample includes 4025 IPOs between 1988 and 2006. Insider holdings is the dollar value of insider holdings at the end of the first day of trading, divided by the total market value of the firm's equity at the end of the first day of trading. Venture capital backing and High-Tech Industry are dummy variables defined by SDC if the issuer is backed by a venture capitalist or in a high-tech industry. Underpricing is the difference between the first closing price and the offer price, divided by the offer price. Reputation is the Carter–Manaster ranking of the lead underwriter (or in the cases of multiple lead underwriters, the average ranking).

Period	*N*	Lockup length		IPO characteristics				
		Mean	St. Deviation	Insider holdings	VC backing	Tech	Underpricing	Reputation
1988–1989	192	238.115	189.884	0.668	0.365	0.339	0.055	7.130
1990–1991	329	229.182	165.056	0.339	0.465	0.444	0.129	7.440
1992–1993	790	223.516	122.538	0.405	0.415	0.376	0.108	6.955
1994–1995	727	231.692	142.209	0.426	0.409	0.476	0.154	6.559
1996–1997	918	221.964	129.214	0.453	0.373	0.516	0.165	6.804
1998–1999	403	208.521	131.130	0.473	0.350	0.586	0.374	6.850
2000–2001	176	195.597	78.648	0.448	0.597	0.750	0.364	7.368
2002–2003	106	186.840	38.897	0.385	0.330	0.406	0.115	7.932
2004–2006	384	189.150	69.536	0.385	0.354	0.393	0.117	7.667

Table 3
Prevalence of 180 day lockup across time, by issue size. The sample is 4025 IPOs between 1988 and 2006. IPOs are categorized according to the proceeds raised in the offering (expressed in January 2000 dollars). Market share of high-quality Banks is the average of a dummy variable set to one if the average Carter–Manaster ranking of lead underwriters is seven or higher.

		Number of IPOs	IPOs not using 180 day lockups	Proportion not using 180 day lockups	Market share of high-quality banks
Large IPOs	1988–1993	140	44	0.314	0.993
(>$80 million real proceeds)	1994–1997	155	38	0.245	0.890
	1998–2000	94	5	0.053	0.883
	2001–2006	292	29	0.099	0.914
Medium IPOs	1988–1993	685	173	0.253	0.892
($20 to $80 million real proceeds)	1994–1997	989	104	0.105	0.865
	1998–2000	338	33	0.098	0.834
	2001–2006	193	10	0.052	0.762
Small IPOs	1988–1993	486	274	0.564	0.342
(<$20 million real proceeds)	1994–1997	501	252	0.503	0.232
	1998–2000	108	66	0.611	0.148
	2001–2006	44	25	0.568	0.159

associated with different average lockup lengths, this time trend may simply reflect intertemporal substitution toward different types of IPOs. Our analysis, however, suggests that this is not the case. Neither the proportion of IPOs underwritten by high-quality banks nor the proportion of IPOs backed by venture capitalists has shown an obvious trend over our sample period. Hence the increased standardization is not apparently due to a trend toward types of IPOs that, for whatever reason, tend to employ 180-day lockups. The proportion of firms in high-tech industries gradually increased from the late 1980s to the late 1990s, and this increase was correlated with increasing standardization on the 180-lockup. However, in the post-bubble period, high-tech prevalence decreased while the standardization continued.

The increased standardization we find has an important parallel in the literature. Chen and Ritter (2000) document a clustering of underwriting fees at exactly 7%, and show that the standardization on this value increased throughout the 1980s and 1990s, particularly for medium sized (proceeds between $20 and $80 million) offerings. Table 3 demonstrates that the same evolution exists in our data. For large offerings (more than $80 million in proceeds) there is a reduction over time in the percent of offerings using any lockup length other than 180 days (from 31.4% for 1988–1993 to 9.9% in 2001–2005), representing a three-fold decrease over our sample period. As in Chen and Ritter, medium sized offerings show an even more dramatic convergence to the use of 180 days—*a five-fold decrease in the proportion of firms not using 180 day lockups*. For small IPOs (less than $20 Million in proceeds) the lockup length has typically been something other than 180 days and there is little apparent trend in its use.

Chen and Ritter (2000) suggest that the standardization of the underwriting fees at 7% may be due to "strategic pricing" in this market; competition based on underwriter quality and analyst coverage rather than fees. Our findings support this conclusion as we document further standardization of the IPO contract (involving another feature of the contract of direct concern to managers[9]) in the segments of the IPO market dominated by the high-quality underwriters (who are most able to compete on quality and analyst reputation) and specifically not in the segment dominated by lower ranked underwriters who are more likely to compete on "price".[10]

4. Empirical tests and results

4.1. Certification: an event study

Our empirical predictions require an identification scheme that will allow us to separate the moral hazard firms from the adverse selection firms. As discussed above, the literature offers several ways to identify subsamples of firms for which the asymmetric information problem is expected to be less acute. We examine strong underwriter reputation, the presence of venture capital financing, and firm size as ways to identify the severity of the asymmetric information problem. To evaluate this identification scheme we note that in an environment of symmetric information, trades are uninformative and have little price impact. In contrast, with asymmetric information, informed trading may be either more or less aggressive than expected and so will (partially) reveal the informed traders' private information, causing fluctuation in stock prices. Further, in a market with a higher expected level of asymmetric information, all trades will have a greater price impact (see for example Kyle (1985) and Milgrom and Stokey (1982)). Asymmetric information should therefore be positively related to dispersion in returns.

Table 4 presents the results of an event study that examines the cross-sectional mean and variability of the cumulative abnormal return (defined as the stock's return minus that of the CRSP value-weighted index) at the expiration of the lockup. The

[9] Chen and Ritter (2000) note on page 1116 that "the objective function of the firm's managers at the time of the offering includes raising money at the time of the offering, and raising money in future open-market insider sales."
[10] Chen and Ritter (2000) suggest that economies of scale and the increase in the total fee are responsible for the standardization being more apparent in the medium sized offerings than in the large.

Table 4
Cumulative abnormal return around lockup expiration. The sample is 4025 IPOs between 1988 and 2006. Abnormal returns for each day are defined as the stock's return minus the return on the CRSP value-weighted index. The table reports the mean and standard deviation of cumulative abnormal returns around the two-day window (−1,0) where $T=0$ denotes the lockup expiration day, as well as a *t*-test for equality of means and Levene's *F*-test for equality of variance. High reputation underwriters are those with Carter–Manaster rank exceeding seven. Size divisions are constructed in two ways: first, by considering the log of market capitalization (in $000s) on the first day of trading and, second, using the IPO proceeds; both values are adjusted to Jan 2000 dollars.

Subsample	Mean CAR		Subsample comparison: equality of means	
			t-stat	*p*-value
Panel A: Means				
Low reputation	−0.032%	Lo vs. Hi	3.067	0.002
High reputation	−0.807%			
Non-VC backed	−0.332%	Non-VC vs. VC	2.781	0.005
VC-backed	−0.950%			
Small IPOs (Ln Mkt Cap <7.114)	−0.434%	Small vs. large	1.646	0.100
Large IPOs (Ln Mkt Cap >7.114)	−0.787%			
Small IPOs (<$20 M)	−0.110%	Small vs. large	1.373	0.170
Medium IPOs ($20 M-$80 M)	−0.818%	Small vs. medium	2.807	0.001
Large IPOs (>$80 M)	−0.554%	Med vs. large	1.042	0.298
Subsample	St. dev. of car		Subsample comparison: equality of variance	
			t-stat	*p*-value
Panel B: St. deviations				
Low reputation	7.66%	Lo vs. hi	13.413	0.000
High reputation	6.192%			
Non-VC backed	6.186%	Non-VC vs. VC	32.457	0.000
VC-backed	7.309%			
Small IPOs (Ln Mkt Cap<7.114)	7.162%	Small vs. large	11.668	0.001
Large IPOs (Ln Mkt Cap>7.114)	6.129%			
Small IPOs (<$20 M)	8.026%	Small vs. large	37.588	0.000
Medium IPOs ($20 M–$80 M)	6.183%	Small vs. medium	10.862	0.001
Large IPOs (>$80 M)	5.629%	Med vs. large	29.729	0.000

data has been split into subsamples based on three criteria: 1) whether the IPO firm was taken public by a high reputation underwriter or not, 2) whether the IPO firm had VC backing or not prior to going public, and 3) firm size.[11]

As a first observation, we note that the 2-day CARs are negative in every subsample considered. Consistent with Bradley et al. (2001) these negative returns are most prominent in the VC-backed and reputable subsamples.

The modest magnitude of these negative average CARs (between 0% and −1% in all subsamples) belies the large volatility therein—an order of magnitude larger. Consider first underwriter reputation. As Panel B indicates, the standard deviation of abnormal returns at the expiration of the lockup is much lower for reputable underwriters ($\sigma=6.19\%$) than for non- reputable underwriters ($\sigma=7.67\%$), and the difference is highly significant (p-value<0.1%). Moving from small IPOs to large IPOs there is an even larger volatility drop, from $\sigma=8.03\%$ to $\sigma=5.63\%$.[12] Both of these patterns provide empirical verification of the arguments advanced by Beatty and Ritter (1986) and Carter and Manaster (1990). In particular, size and underwriter certification serve to reduce the asymmetry of information.

The evidence for venture capital certification is less clear. Panel B of Table 4 shows that the cross-sectional variance of abnormal returns at the expiration of the lockup period is actually greater if the firm has had venture capital financing. This reversal may be due to a confounding factor: the lockup expiration period is associated with the sales of both managerial insiders and VCs, and the higher variance may be driven by price pressure from the VC's liquidation of their positions. Alternatively, as the VC's shares are typically "locked" along with the insider's, VCs may serve a monitoring function as well as a certification role, clouding the resulting separation of the firms for our purposes. Finally, the effect of reputation may be stronger for high-quality underwriters than for the *typical* VC, whereas our indicator variable does not account for differences in VC quality.

Based on the findings in Table 4, we present the balance of our analysis using firm size and underwriter reputation as proxies for the relative severity of the asymmetric information problem.

4.2. Relation of lockup length with underpricing and insider ownership

Hypotheses 1a and 1b considers the correlation between lockup length and the level of underpricing across the sets of moral hazard (high reputation underwriters or large firms) versus asymmetric information firms (low reputation underwriters or small

[11] Firm size is measured by market capitalization post-IPO. For consistency with Table 3, we also report results using the definition of size in Chen and Ritter (2000).

[12] The results presented use a two-day window around the lockup expiration (−1, 0). These results are unchanged using alternate windows (*e.g.* (−2, 2)).

Table 5
Correlations between key variables, by underwriter rank. The sample is 4025 IPOs between 1988 and 2006. *Hi-Rep* designates IPOs for which the Carter–Manaster ranking of the lead underwriter (or average ranking, in the case of multiple lead underwriters) is seven or higher. Size divisions are constructed in two ways: first, by considering the log of market capitalization (in $000s) on the first day of trading and, second, using the IPO proceeds; both values are adjusted to Jan 2000 dollars.

	Panel A: unconditional correlations				Panel B: partial correlations			
	Lockup and underpricing [a]		Lockup and insider holdings [b]		Lockup and underpricing [a]		Lockup and insider holdings [b]	
	Correlation	Sig. (two-tailed)	Correlation	Sig. (two-tailed)	Correlation	Sig. (two-tailed)	Correlation	Sig. (two-tailed)
Full Sample	0.027	0.103	0.015	0.422	0.081	0.000	−0.041	0.024
Small IPOs (Ln Mkt Cap<7.114)	0.217	0.000	0.089	0.000	0.152	0.000	−0.003	0.919
Large IPOs (Ln Mkt Cap>7.114)	−0.009	0.711	−0.114	0.000	0.012	0.766	−0.094	0.000
Small IPOs (<$20 M)	0.229	0.000	0.073	0.032	0.168	0.000	0.022	0.520
Large IPOs (>$80 M)	−0.028	0.497	−0.232	0.000	0.012	0.766	−0.207	0.000
Lo-Rep	0.182	0.000	0.084	0.010	0.179	0.000	0.010	0.750
Hi-Rep	−0.035	0.074	−0.099	0.000	−0.023	0.240	−0.094	0.000

[a] Partial correlation controlling for venture capital backing, percentage of primary shares offered, the logarithm of real proceeds (in Jan 2000 dollars) a dummy variable indicating if the IPO is in a high-tech industry, and price revision (the percentage change between the midpoint of the filing price range and the offer price).
[b] Partial correlation controlling for venture capital backing, percentage of primary shares offered, the logarithm of real proceeds (in Jan 2000 dollars) and a dummy variable indicating if the IPO is in a high-tech industry.

firms). The first two columns of panel A of Table 5 report the Pearson correlations between lockup length and underpricing for the subsamples based on firm size and the reputation of the underwriter. These columns provide support for Hypotheses 1a and 1b. As predicted, there is a significantly positive correlation between underpricing and lockup length in the asymmetric information subsamples (small firms and low reputation underwriters). The correlations are not significantly different from zero at the 5% level in the moral hazard subsamples. Note that the small positive correlation between these variables in the full sample is insignificant, and that this result masks the strong subsample differences.

Strictly speaking, our predictions are developed considering a single "comparative static" change. We should, therefore, control for other characteristics of the firm or the offering that may affect the lockup length, underpricing, and/or insider holdings before we consider the relationships between these variables. In the first two columns of panel B of Table 5 we present the partial correlations between lockup length and underpricing. Intuitively, the partial correlation represents the correlation between the variables of interest once they have been homogenized with respect to the associated control variables.[13]

The results in panel B of Table 5 are also consistent with Hypotheses 1a and 1b. The estimate of the partial correlation between lockup length and underpricing for the asymmetric information firms is positive and significantly different from zero (p-value<0.1%). In contrast, in the samples of moral hazard firms the estimated the partial correlation between underpricing and lockup length are an order of magnitude smaller than in the asymmetric information subsamples and are insignificantly different from zero in all cases.

Panels A and B of Table 5 also provide strong support for Hypothesis H3. The third and fourth columns of Panel A report estimates of correlation between lockup length and insider holdings, measured as the natural log of the dollar value of insider shares, that are negative and significant for each of the moral hazard subsamples samples and non-negative (significantly positive) in each of the asymmetric information subsamples. Panel B presents the partial correlations between lockup length and insider holdings. For all of the moral hazard subsamples the estimated partial correlations are negative and significant (p-value<0.1%). While all of the asymmetric information subsamples show partial correlations that are insignificantly different from zero. Measuring insider ownership using percent of shares outstanding provides the same qualitative results. These findings are all consistent with the prediction of Hypothesis 3.

Finally, note that the results in panel B of Table 5 underscore the necessity of separating asymmetric information firms from the moral hazard firms, as the subsamples display quite different co-movements among the key variables. The results from the full sample are consistent with both a moral hazard and an asymmetric information motive for the lockup.

4.3. The impact of asymmetric information on lockup length and underpricing

Hypothesis 2 concerns a deeper examination of the effects of asymmetric information on underpricing and lockup length. This hypothesis suggests that underpricing should be increasing in the amount of asymmetric information for both the moral hazard

[13] Specifically, the partial correlation between lockup length and underpricing is the correlation between the residuals of regressions of lockup length on a set of control variables and underpricing on the same set of controls. See Greene (2008), Chapter 3.4. The control variables used in computing the partial correlation between lockup length and underpricing are the percentage of primary shares offered, the log of real proceeds, dummy variables indicating venture capital backing and whether the IPO is in the high tech industry, the price revision (the percentage change between the midpoint of the filing range and the offer price), and a measure of industry momentum (average return of public firms in the same Fama–French 48 industry classification between the filing and offer dates). Partial correlation between lockup length and insider holdings is constructed similarly.

Table 6
Determinants of underpricing. This table presents the coefficients and associated *t*-statistics, in parentheses, from an OLS regression in which the dependent variable is IPO underpricing. Independent variables include time- series volatility, measured as the standard deviation of residuals from a market model where the event window is seventy days before the lockup expiration (excluding ten days immediately prior to lockup expiration). Insider represents the post-IPO holdings of firm insiders measured either as a percent of outstanding equity, or as the logarithm of the dollar value of insider ownership in thousands of dollars. Control variables include the primary shares sold in the IPO as a percentage of total shares sold, a dummy variable set to 1 if the issuing firm is a high-tech firm, the natural log of real proceeds (converted to January 2000 dollars using the GDP deflator), a dummy indicating whether the IPO was backed by venture capitalists, and the price revision (the percentage change from the midpoint of the filing range to the offer price).

	Full sample		Large IPOs		Small IPOs		High-rep underwriter		Low-rep underwriter	
Intercept	0.049	−0.633***	0.010	−0.783***	0.083*	−0.213***	0.075	−0.672***	0.002	−0.556***
	(1.00)	*(10.44)*	*(.117)*	*(−6.99)*	*(2.64)*	*(−3.94)*	*(1.36)*	*(−9.36)*	*(.019)*	*(−5.52)*
Volatility	1.31***	1.11***	1.65**	1.06	0.481**	0.586***	1.22**	0.631	0.751**	0.903***
	(4.01)	*(3.62)*	*(2.08)*	*(1.39)*	*(2.13)*	*(2.66)*	*(2.20)*	*(1.20)*	*(2.10)*	*(2.67)*
Insider (%)	0.093***		0.043		−0.021		0.113***		0.040	
	(2.80)		*(0.751)*		*(−0.727)*		*(2.74)*		*(0.764)*	
Insider (Ln $)		0.111***		0.121***		0.054***		0.119***		0.090***
		(17.69)		*(10.51)*		*(9.05)*		*(15.30)*		*(8.62)*
Primary shares	0.024	0.005	0.048	0.042	−0.080**	−0.093**	0.013	−0.002	0.022	0.001
(%)	*(0.599)*	*(0.124)*	*(0.719)*	*(0.655)*	*(−2.12)*	*(−2.55)*	*(0.262)*	*(−0.035)*	*(0.281)*	*(0.010)*
Tech	0.036**	0.013	0.075**	0.038	0.001**	−0.004	0.050**	0.019	0.038*	0.032
	(2.33)	*(0.886)*	*(2.51)*	*(1.33)*	*(0.086)*	*(−0.301)*	*(2.42)*	*(0.959)*	*(1.71)*	*(1.52)*
Ln(proceeds)	−0.095***	−0.106***	−0.061	−0.185***	−0.093***	−0.149***	0.192***	−0.037	−0.017	−0.167***
	(3.75)	*(−4.02)*	*(−1.12)*	*(3.50)*	*(−3.58)*	*(−5.76)*	*(5.54)*	*(1.05)*	*(−0.478)*	*(−4.42)*
Rank dummy	0.016	−0.015	0.021	*	−0.017	−0.029**	*	*	*	*
	(0.819)	*(−0.828)*	*(0.466)*	*	*(−1.19)*	*(−2.05)*	*	*	*	*
VC dummy	0.038**	0.034**	0.048*	0.052*	−0.029**	−0.023*	0.062***	0.051***	−0.011	0.006
	(2.46)	*(2.32)*	*(1.70)*	*(1.93)*	*(−2.22)*	*(−1.86)*	*(3.14)*	*(2.76)*	*(−0.416)*	*(0.254)*
Price revision	0.168***	0.159***	0.257***	0.254***	0.047*	0.047*	0.199***	0.186***	0.032	0.036
	(5.06)	*(5.05)*	*(4.40)*	*(4.53)*	*(1.72)*	*(1.75)*	*(4.84)*	*(4.78)*	*(0.610)*	*(0.716)*
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Adjusted R^2	0.128	0.221	0.137	0.183	0.052	0.106	0.163	0.257	0.048	0.061
N	2645	2624	1259	1259	1365	1365	1813	1782	832	820
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Statistical significance at the 1%, 5% and 10% level is denoted by the symbols ***, ** and * respectively.

and the asymmetric information firms as asymmetric information is a determinant of underpricing of IPOs in general. Furthermore, for the asymmetric information firms, lockup length should also be increasing in a measure of asymmetric information. This relationship between asymmetric information and underpricing and asymmetric information and lockup length generates the relationship between lockup length and underpricing examined in Hypothesis 1a. By considering the mechanism underlying the relationship between lockup length and underpricing, Hypothesis H2 represents a more stringent test of Hypotheses 1a and 1b.

Hypothesis H2 is examined in Tables 6 and 7. These models use a measure of asymmetric information and control variables suggested by the prior literature (*e.g.*, Brav and Gompers (2003) or BLM (2005)) as the determinants of the underpricing and lockup length. Our measure of asymmetric information follows Bradley et al. (2001) who consider the daily volatility of idiosyncratic returns (using a seventy day window that ends ten days prior to lockup expiration[14]) defined as the standard deviation of residuals from a simple market model regression. The return on the CRSP value-weighted index is taken as a proxy for the market portfolio's return.

Table 6 presents the analysis for the determinants of underpricing in the different samples. For each sample, the full sample, the moral hazard samples, and the asymmetric information samples we estimated two versions of a model explaining underpricing. The difference between the models lies in the way insider holdings are measured; as a percent of shares outstanding or as the natural logarithm of the dollar value of insider holdings. Hypothesis 2 suggests that the measure of asymmetric information (*volatility*) will be positively related to underpricing for all firms. Table 6 shows that this is indeed the case. In eight of the ten models the estimated coefficient on volatility, our measure of asymmetric information) is positive and highly significant. In the large firm sample and the high reputation underwriter subsample (for which asymmetric information has been argued to be diminished) when we use the dollar value of insider holdings as a measure of post-IPO insider holdings this coefficient is positive but insignificant. These results are consistent with asymmetric information being a significant determinant of underpricing for all firms.[15]

[14] Citing underwriter price support, Bradley et al. (2001) suggest that using the window immediately before the lockup expiration is preferable to the window immediately after trading commences (e.g., days +1 to +71). This argument takes particular importance in our setting because price support practices may differ between low-quality and high-quality underwriters.

[15] One should note that the adverse selection problem (see Rock (1986)) is not the only determinant of underpricing discussed in the literature. Loughran and Ritter (2004) argue that over time a changing issuer objective to attract more analyst coverage and heightened moral hazard on the part of underwriters and issuing executives became important determinants of underpricing from 1990 onward. Our results only require that asymmetric information be a significant determinant of underpricing, not that it is the sole determinant.

Table 7
2SLS determinants of lockup length. This table presents the coefficients and associated *t*-statistics, in parentheses, from a 2SLS regression. In the first stage, we estimate the determinants of insider ownership after the IPO. Control variables include pre-IPO insider ownership, dummies indicating venture capital backing or high-tech industry affiliation, and aftermarket volatility (measured as the standard deviation of residuals of a market model estimated as in Table 6). In the second stage, the dependent variable is the length of the lockup. Independent variables include time-series volatility and the predicted insider ownership, imported from the first stage. Control variables include the primary shares sold in the IPO as a percentage of total shares sold, a dummy variable set to 1 if the issuing firm is a high-tech firm, the natural log of real proceeds (converted to January 2000 dollars using the GDP deflator), a dummy indicating whether the IPO was backed by venture capitalists, and the price revision (the percentage change from the midpoint of the filing range to the offer price).

	Full sample		Large IPOs		Small IPOs		High-rep underwriter		Low-rep underwriter	
Intercept	146.2***	167.5***	183.9***	215.3***	49.04*	54.13	174.4***	222.1***	−67.22	−88.21
	(10.06)	*(8.67)*	*(14.58)*	*(12.92)*	*(1.88)*	*(1.54)*	*(21.63)*	*(20.00)*	*(−1.55)*	*(−1.48)*
Volatility	1273.0***	1249.9***	−12.10	16.37	1512.6***	1521.5***	44.58	85.25	1677.9***	1654.1***
	(13.21)	*(13.05)*	*(−0.108)*	*(0.146)*	*(11.06)*	*(11.09)*	*(0.534)*	*(1.03)*	*(8.90)*	*(8.70)*
Insider (%)	21.30**		−0.369		61.77***		0.188		97.10***	
	(1.96)		*(−0.040)*		*(3.33)*		*(0.027)*		*(3.21)*	
Insider (Ln $)		−1.97		−4.74***		3.31		−3.96***		11.00*
		(−.939)		*(−2.71)*		*(0.813)*		*(−3.05)*		*(1.67)*
Primary Shares (%)	49.85***	50.85***	29.64***	30.54***	51.61**	51.67**	31.78***	31.87***	105.7**	100.7**
	(4.16)	*(4.26)*	*(3.16)*	*(3.27)*	*(2.31)*	*(2.30)*	*(4.46)*	*(4.46)*	*(2.56)*	*(2.44)*
Tech	−16.50***	−15.87***	−6.75	−5.26	−13.31*	−12.63*	−5.01	−3.97	−8.90	−10.58
	(−3.61)	*(−3.47)*	*(−1.59)*	*(−1.24)*	*(−1.84)*	*(−1.74)*	*(−1.63)*	*(−1.30)*	*(−0.770)*	*(−0.900)*
Ln(Proceeds)	−29.08***	−23.61***	30.99***	37.10***	−105.6***	−113.1***	37.28***	43.74***	−130.2***	−148.9***
	(−4.01)	*(−2.83)*	*(4.22)*	*(4.85)*	*(−6.85)*	*(−6.81)*	*(7.46)*	*(7.81)*	*(−7.21)*	*(−6.60)*
Rank dummy	−51.61***	−49.84***	−7.41	−7.01	−41.71***	−42.26***	*	*	*	*
	(−9.21)	*(−8.94)*	*(−1.17)*	*(−1.11)*	*(−4.93)*	*(−4.97)*	*	*	*	*
VC dummy	−30.51***	−29.75***	−12.42***	−12.53***	−23.95***	−27.72***	−12.26***	−12.08***	−26.63**	−26.89**
	(−6.66)	*(−6.59)*	*(−3.11)*	*(−3.16)*	*(−3.07)*	*(−3.58)*	*(−4.16)*	*(−4.17)*	*(−2.01)*	*(−2.02)*
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Adjusted R^2	0.221	0.213	0.067	0.072	0.267	0.262	0.071	0.075	0.239	0.231
N	2893	2810	1327	1327	1483	1483	1979	1931	914	879
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Statistical significance at the 1%, 5% and 10% level is denoted by the symbols ***, ** and * respectively.

The other coefficient estimates are consistent with the existing literature. Measures of insider holdings are positively related to underpricing as is proceeds from the offer. The VC dummy, the price revision between the offer price and the mid-point of the offer range, and an industry momentum measure (industry return) are generally positively related to underpricing.

Table 7 considers the determinants of lockup length. For each sample, the full sample, the moral hazard samples, and the asymmetric information samples we estimate two versions of a model considering the determinants of lockup length. The difference in the models again lies in how insider holdings are measured; as a percent of outstanding shares after the IPO as the log of the dollar value of insider ownership. In this case, because it may be argued that lockup length and post-IPO insider ownership are jointly chosen, we control for the potential endogeneity associated with using post-IPO insider ownership as an independent variable by using a two-stage regression analysis. In the first stage post-IPO insider ownership is estimated using control variables and pre-IPO ownership as the primary instrument. The estimated values of post-IPO ownership from this first stage regression are then used as an independent variable in the regression model presented in Table 7. The important findings are that, consistent with Hypothesis 2, in the moral hazard samples asymmetric information (volatility) is not a statistically significant determinant of lockup length. In contrast, in the asymmetric information samples, asymmetric information is a significantly positive determinant of lockup length.

The other determinants of lockup length are generally quite intuitive and consistent with the prior literature. The percent of primary shares sold in the IPO is positively related to lockup length in all the samples. The high-tech dummy and the VC dummy are negatively related to lockup length. As in our previous findings and consistent with Hypothesis H3, insider holdings have a significantly negative relationship with lockup length in the moral hazard sample but no relationship with lockup length in the asymmetric information sample. Interestingly, the proceeds from the IPO have a significantly positive relationship with lockup length in the moral hazard sample but a significantly negative relationship with lockup length in the asymmetric information sample. Thus, within the set of large firms and those taken public by high reputation underwriters, larger issues are associated with a longer lockup while within the set of small firms and low reputation underwriters, larger issues are associated with a shorter lockup.

Tables 6 and 7 are, therefore, consistent with the hypothesis that the economic mechanism that drives the differential correlations between underpricing and lockup length across the moral hazard and the asymmetric information subsamples is heterogeneity in the level of asymmetric information and market reactions to this circumstance.

5. Conclusions

We conjecture that, depending upon firm characteristics, the length of the lockup period in an IPO is chosen to solve either a moral hazard or an asymmetric information problem. The main empirical implication of this conjecture is that there should be a

positive correlation between lockup length and underpricing in the cross section of a sample of firms for which the asymmetric information problem determines the length of the lockup. For a complementary sample of firms for which the lockup is chosen to address a managerial moral hazard problem there should be no correlation between the lockup length and the underpricing in the IPO. The intuition for this prediction can be explained by simply noting that underpricing is driven by asymmetric information, not by moral hazard. Thus increasing the severity of the asymmetric information problem should impact underpricing and lockup length for the asymmetric information firms but only underpricing for the moral hazard firms.[16] In order to identify moral hazard and asymmetric information firms the literature has argued for the use of firm size and underwriter reputation as proxy variables. We first present empirical results supporting the use of these proxy variables and use them to test our hypotheses. Once we separate the subsamples of firms, the data supports our prediction concerning the differential correlation between underpricing and lockup length across the subsamples of firms.

On a deeper level the data is also consistent with the notion that the economic mechanism that explains the differential correlation between underpricing and lockup length is the heterogeneity in asymmetric information across the two subsamples of firms. The results show that asymmetric information is a determinant of underpricing in both subsamples of firms but is a determinant of the lockup length only in the asymmetric information subsample.

We also consider the implications of changes in the severity of the managerial moral hazard problem and argue it predicts a negative correlation between lockup length and the proportion of equity owned by firm insiders after the IPO for moral hazard firms but a nonnegative correlation between these variables for asymmetric information firms. Once again, the results are strongly consistent with this hypothesis.

The nature of our hypotheses and our empirical results demonstrate the importance of identifying the moral hazard firms and the asymmetric information firms when examining the motivation for the use of the lockup provision. Without an ex-ante identification of the moral hazard and the asymmetric information firms we present evidence that could be interpreted as supporting asymmetric information as the determinant of the length of the lockup provision as well as evidence that could be interpreted as supporting moral hazard as the determinant of lockup length for the average firm.

Our empirical analysis also identifies two striking facts regarding the degree of standardization on the 180 day lockup. IPOs underwritten by high-quality underwriters, and to a lesser degree VC-backed IPOs, are much more likely to use exactly this lockup period. In addition, the degree of standardization for medium and large sized offers increased substantially in each of the subsamples throughout our sample period. This intertemporal trend does not appear to be explained by the changing composition of firms in our sample, and our analysis sheds no light on this matter, and so while this finding is consistent with the results and conclusions of Chen and Ritter (2000) it constitutes an unresolved puzzle.

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References

Allen, F., Faulhaber, G., 1989. Signaling by underpricing in the IPO market. Journal of Financial Economics 23, 303–323.
Benveniste, L., Spindt, P., 1989. How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics 24, 343–361.
Bradley, D.J., Jordan, B., Yi, H., Roten, I., 2001. Venture capital and IPO lockup expiration: an empirical analysis. Journal of Financial Research 24, 465–493.
Brau, J., Lambson, V., McQueen, G., 2005. Lockups revisited. Journal of Financial and Quantitative Analysis 40, 519–530.
Brav, A., Gompers, P., 2003. The role of lockups in initial public offerings. Review of Financial Studies 16, 1–29.
Beatty, R., Ritter, J., 1986. Investment banking. Reputation and the underpricing of initial public offerings. Journal of Financial Economics 15, 213–232.
Carter, R., Manaster, S., 1990. Initial public offerings and underwriter reputation. Journal of Finance 45, 1045–1068.
Chen, H., Ritter, J., 2000. The seven percent solution. Journal of Finance 55, 1105–1131.
Field, L., Hanka, G., 2001. The expiration of IPO share lockups. Journal of Finance 56, 471–500.
Garfinkel, J., 1993. IPO underpricing, insider selling and subsequent equity offerings: is underpricing a signal of quality? Financial Management, Spring. 74–83.
Grinblatt, M., Hwang, C., 1989. Signalling and the pricing of new issues. Journal of Finance 44, 393–420.
Ibbotson, R., Ritter, J., Sindelar, J., 1994. The market's problem with the pricing of initial public offerings. Journal of Applied Corporate Finance 7, 66–74.
Jain, B., Kini, O., 1994. The post-issue operating performance of IPO firms. Journal of Finance 49, 1699–1726.
Jegadeesh, N., Weinstein, M., Welch, I., 1993. An empirical investigation of IPO returns and subsequent equity offerings. Journal of Financial Economics 34, 153–175.
Jenkinson, W., Ljungqvist, A., 2001. Going Public: The Theory and Evidence on How Companies Raise Equity Finance, 2nd ed. Oxford University Press.
Kyle, A., 1985. Continuous auctions and insider trading. Econometrica 53, 1315–1335.
Loughran, T., Ritter, J., 2004. Why has IPO underpricing changed over time? Financial Management 33, 5–37.
Megginson, W., Weiss, K., 1991. Venture capitalist certification in initial public offerings. Journal of Finance 46, 879–903.
Michaely, R., Shaw, W., 1994. The pricing of initial public offerings: tests of adverse-selection and signaling theories. Review of Financial Studies 7, 279–319.
Milgrom, P., Stokey, N., 1982. Information, trade and common knowledge. Journal of Economic Theory 26, 17–27.
Ritter, J., Welch, I., 2002. A review of IPO activity pricing, and allocations. Journal of Finance 57, 1795–1828.

[16] One should note that the adverse selection problem that determines underpricing (see Rock (1986)) is not the only determinant of underpricing discussed in the literature. Loughran and Ritter (2004) argue that over time a changing issuer objective to attract more analyst coverage and heightened moral hazard on the part of underwriters and issuing executives became important determinants of underpricing from 1990 onward. Our results only require that asymmetric information be a determinant of underpricing, not that it is the sole determinant.

Rock, K., 1986. Why new issues are underpriced. Journal of Financial Economics 15, 187–212.
Spiess, K., Pettway, R., 1997. The IPO and first seasoned equity sale: issue proceeds. owner/manager's wealth, and the underpricing signal. Journal of Banking and Finance 21, 967–988.
Wang, W., Yung, C., in press. IPO Information Aggregation and Underwriter Quality, Forthcoming in the Review of Finance.
Welch, I., 1989. Seasoned offerings, imitation costs, and the underpricing of initial public offerings. Journal of Finance 44, 421–449.
Yung, C., Colak, G., Wang, W., 2008. Cycles in the IPO market. Journal of Financial Economics 89, 192–208.