Private Information and the Granting of Stock Options

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Abstract

We examine the relation between firms' grants of executive stock options and the presence of positive private information about the firm. Firms privately receive notices of forthcoming patents and have a period of time before that information is made public. We examine whether firms' option-granting behavior during this period of time, relative to a benchmark period, is consistent with CEOs receiving more option grants based on that private information. Our tests suggest that firms use that information to provide more valuable option grants to CEOs and, further, that firms' option-granting behavior during the private-information period is related to their reliance on innovation and the value of the patent received. We also find that the increase in option granting is concentrated in periods when the US Patent and Technology Office does not publish information about patent applications prior to issuing patents, and that CEOs appear to benefit more broadly from patent-related private information than outside directors do. Overall, we provide support for our expectation that firms with private information about a forthcoming patent use that information to provide more valuable option grants to their CEO.

1. Introduction

The granting of executive stock options presents opportunities for strategic behavior. For example, Aboody and Kasznik (2000) examine whether CEOs opportunistically time their voluntary disclosures around stock option awards. Studying a sample of firms with fixed option award schedules, they document that managers appear to delay bad news and accelerate good news in order to maximize their stock option compensation. Similarly, Devos et al. (2015) examine the timing of option grants to CEOs around the announcement of stock splits. They find that option grants are more likely to precede the stock split, enabling CEOs to benefit from the stock price appreciation that typically accompanies a stock split. Lie (2005) and Heron and Lie (2007) find widespread evidence consistent with companies backdating option grants to increase the value of option compensation. Like these studies, we examine strategic behavior in the granting of stock options. We identify periods when a firm has private information about the future receipt of a patent and then examine the timing of stock option grants around that private information period. A large literature suggests that insiders with private information will use that information to structure transactions such that they personally benefit from the information.[1] Few studies, however, provide systematic direct evidence of the association between specific private information and firm-initiated transactions.

Our setting provides several unique features. First, we are able to isolate a specific source of private information (available only to the firm), as well as the points in time when the firm receives the information and when the information becomes public. Furthermore, the private information about a pending patent is never "bad news," and the value of that private information

[1] For example, Aboody and Lev (2000) propose that R&D expenditures increase information asymmetry between managers and shareholders, leading to opportunities for insider gains. Consistent with their expectations, they provide indirect evidence of this relation: they document that "insider gains in firms conducting R&D are substantially larger than insider gains in firms with no R&D activities" (pg. 2749).

to the firm can be estimated using techniques drawn from prior research. Finally, unlike prior research, the timing of the information endowment is exogenous to the firm, allowing us to isolate firms' decisions to grant options rather than examining decisions involving both the release of information and grants of options.

To obtain the information used in this study, we construct a database using details about the patent-issuance process downloaded from the US Patent and Technology Office (USPTO). This information is made available to the public subsequent to the issuance of the patent. Prior to issuing a patent, however, the USPTO notifies the applicant that the patent is *pending approval* (forthcoming). This Notice of Allowance (NOA) is mailed to the applicant and, if the applicant pays the required fees within a three-month period, the patent will be issued by the USPTO.[2] The USPTO holds its issuance of an NOA strictly confidential and public announcement of the receipt of an NOA by a patent recipient is rare (Lansford, 2006).[3] Thus, the firm has private information for the period between its receipt of the mailed NOA and the date the patent issuance information is published in the USPTO's weekly *Official Gazette*.[4,5] Note that even after the firm has applied for a patent, there is still substantial uncertainty about both the timing of the patent issuance and the claims that will be allowed by the patent examiner. Carley et al. (2015) find that 56% of patent applications result in patents without the use of continuances, and far fewer (11%)

[2] The Appendix R Patent Rules from the USPTO state, "If, on examination, it appears that the applicant is entitled to a patent under the law, a *notice of allowance* will be sent to the applicant at the correspondence address. … The sum specified in the notice of allowance may also include the publication fee, in which case the issue fee and publication fee … must both be paid within three months from the date of mailing of the notice of allowance to avoid abandonment of the application (emphasis added)." For more details, see http://www.uspto.gov/web/offices/pac/mpep/documents/appxr_1_311.htm.

[3] Lansford (2006) finds that few of his sample firms voluntarily disclose the NOAs. Specifically, Lansford reviews over 10,000 patent-related articles issued by companies from January 1990 to November 2000 and can identify only 203 instances where companies voluntarily disclosed the receipt of an NOA. A total of 430,546 patents were issued during this period. We discuss this in more detail in section 3.2.

[4] Patents that are issued by the USPTO are announced via the weekly *Official Gazette*, which is published every Tuesday and includes information on patents issued in the previous week. This is a public event and provides the point in time when the patent-pending private information becomes public.

[5] The American Inventors Protection Act required that most patent applications filed after November 29, 2000 be published by the USPTO 18 months after filing. We discuss this Act in more detail below.

are allowed without additional rounds of amendments or negotiations with the patent examiner. The NOA resolves that uncertainty for the patent applicant. Furthermore, an NOA represents favorable information to the patent applicant, as the receipt of an NOA declares the USPTO's intention to issue a patent that allows firms the possibility of extracting stable monopoly rents.[6]

We exploit this setting—the presence of specifically identifiable positive private information—to provide evidence about strategic decisions to grant options to insiders. We compare options granted during the period when the firm has private information (the "private-event window") to options granted during a benchmark window of the same length during the prior year. We also consider the importance of innovation to the firm (measured by research and development expense as a percentage of sales) and estimate the expected value of the forthcoming patents (using future patent citations). These measures capture situations where we expect the private information has greater value to the firm. We examine the association between these measures and the options granted during the private-event window relative to the benchmark window.

In univariate analyses of the full sample of patents and subsamples constructed to help us isolate firms' option-granting behavior, we find evidence of increased option grants during the private-event window. Both the number of options granted and the probability of granting options are greater during the private-event window than during the same window in the prior year. The results are fairly consistent across the full sample and our subsamples, and for both the number of options granted and the likelihood that options were granted. In multivariate analyses, we find strong evidence that option grants during the private-event window are larger (more likely) when innovation is important to the firm, after controlling for other factors that may affect option grants. We also provide limited evidence that when the value of the patent is expected to

[6] Patents give patent holders the exclusive right to use their invention for 20 years after the patent application date.

be greater, CEOs are granted more options (and are more likely to receive options) during the private-event window. When we restrict the sample to observations where the abnormal return to the USPTO patent announcement was positive or the number of citations was in the top decile for all patents, we continue to find larger option grants during the private-event window, particularly as the firm's R&D increases.

We conduct two additional sets of analyses. First, we partition the sample based on whether the patent application was filed before the American Investors Protection Act (AIPA) of 1999 took effect. As we discuss below, the AIPA potentially reduces the private information available to the firm when it receives an NOA from the patent office because it may result in the USPTO's publication of a patent application in advance of the NOA. The results of these tests suggest that our finding of greater option grants in the private-event window holds mainly in the pre-AIPA period. Second, we attempt to shed some light on whether option grants following NOAs are primarily a means to exploit private information or also serve to reward CEOs for successful innovation. Reasoning that options granted to the firm's outside directors might exploit private information but are unlikely to be a reward, we repeat several of the analyses of option grants to CEOs during the private-event window using option grants to the firm's outside directors. Similar to the CEO results, we find larger option grants to outside directors during the private-event window. In contrast to the results for CEOs, we do not find higher likelihood of an option grant during the private-event window, and the larger option grants during the private-event window appear to be driven by increases in the firm's R&D.

Overall, our evidence suggests that firms grant more options to their CEO when the firm has private information relating to a forthcoming patent. The increase in option grants is greater when innovation is more important to the firm and also when patents are expected to be more

valuable. Similar but weaker option grants patterns exist for outside directors on the board, suggesting that option grants may be both a way to exploit private information and a way to reward the CEO for innovation.

The rest of the paper proceeds as follows. Section 2 discusses background literature and develops hypotheses. Section 3 describes the research design. Section 4 presents our empirical results, and Section 5 concludes.

2. Background and hypotheses development

Prior research has examined stock option grants around information events. Yermack (1997) finds evidence that stock option grants precede positive news and follow insignificantly negative stock returns. While these findings support the idea that firms time stock option grants opportunistically, they could also be interpreted as opportunistic timing of the release of information around predetermined option grants. To disentangle these two explanations, Aboody and Kasznik (2000) identify stock option grants that appear to occur at predetermined intervals (within five days of the same date in the prior year). They then examine stock price movements, as well as management forecasts around these grants, and find that managers tend to release bad news prior to stock option grants and good news after. These findings are consistent with firms timing the release of information opportunistically. Devos et al. (2015) provide evidence similar to Yermack (1997) but in a more specific context—the announcement of a stock split. The authors investigate whether stock option grants are timed to allow CEOs to benefit from the positive abnormal return that typically accompanies the announcement of a stock split. When they examine option grants in the 21-day period surrounding the stock split announcement, they find that approximately 80% of the grants occur prior to the announcement. This evidence is consistent with the opportunistic timing of CEO option grants relative to stock split

announcements. Because the stock split announcements are discretionary, the authors are unable to disentangle whether CEOs are opportunistically timing the announcement of the stock split, the option grants, or both. Thus, it remains an open question as to whether CEOs have the ability to influence stock option grants in response to private information.

To examine whether firms exploit patent-related private information, we study option-granting behavior during the window when the firm has patent information not yet publicly released. The granting of options provides an ideal setting for several reasons. First, because stock options typically are granted with the exercise price equal to the market price on the date granted, recipients benefit from receiving options before an expected increase in stock price. Since the patent-related private information holds only upside potential for firms (the information may be good or neutral news, but it is never bad news), the stock options will be most valuable if granted before the market impounds information about the patent approval. Thus, if firms use option grants to exploit the information, there will be an increase in options granted during the period when the patent information is private. Second, grants of stock options do not require an insider to have sufficient liquidity to buy shares prior to potential stock price increases. Option strike prices are only paid when the options vest and are subsequently exercised. Third, unlike share purchases (or sales) and option exercises, the granting of stock options does not constitute a "purchase" or "sale" and thus is not subject to Rule 10b-5.[7] Consistent with this distinction between option grants and share purchases/sales, Rogers and Stocken (2005) find evidence of opportunistic forecasting behavior by insiders in advance of option grants, but the same opportunistic behavior is only evident in open-market transactions in

[7] The SEC "no sale" doctrine applies to grants of employee options pursuant to stock bonus plans because the employee does not independently bargain for it (SEC Rule 33-6188). This has been upheld in No-Action letters (see, for example, Compass Group PLC, SEC No-Action Letter, 1999 WL 311797, May 13, 1999) and used in in legal proceedings (see, for example, In Re Cendant Corporate Securities Litigation).

settings where it is difficult for the market to detect opportunism. Finally, the information event is exogenous to the timing of the option grants. While the information release could affect the grant of stock options, the grant of stock options by the firm cannot affect the timing of the information release from the USPTO.

Why would a board choose to grant stock options during the patent-related private-event period? Stock options can be a reward for prior performance as well as a means of aligning the incentives of managers with shareholders, since options provide monetary rewards for option recipients when stock prices increase. Indeed, they are a significant part of executive compensation, particularly in firms that engage in R&D (see, for example, Guay 1999; Coles et al. 2006; and Ryan and Wiggins 2002). If boards are seeking to maximize the value of options granted to the executive, this could be accomplished by granting them prior to an expected rise in stock price – like when a patent has been issued. Heron and Lie (2007) cite a similar rationale for the practice of backdating option grants. Likewise, Devos et al. (2015) speculate that the apparent opportunistic timing of option grants around stock splits may be a means for boards to reward and retain good CEOs. In the case of patents, granting stock options in response to the receipt of an NOA may be efficient contracting. As noted earlier, recent research documents that a little more than 50% of applications result in patents without the use of continuation procedures, suggesting that applying for a patent is no guarantee of receiving one (Carley et al., 2015). Rewarding CEOs for success in innovation, and maximizing that reward by allowing CEOs to benefit from stock market response to the good news, may be an effective compensation strategy. This point is made particularly salient by Manso (2011), who shows that stock options are an important compensation tool for encouraging innovation.

Based on the above discussion, we anticipate option grants will be larger after the receipt of an NOA and prior to the public notification of the patent approval than they are at other times.

3. Sample selection and research design

3.1 Sample selection

We start our sample selection process with the NBER Patent Project database. This database includes 922,696 utility patents issued between 1986 and 2006 and provides Compustat links to the firm receiving the patent.[8] We match these patents to additional information from the USPTO database about the timing of the NOA and the issuance of the patent. For 762,483 patents (issued to 4,857 unique firms), we are able to obtain detailed information about the date that the NOA was mailed to the patent recipient and the subsequent date that the patent issuance notification was mailed.[9] We drop 180,712 patents that were issued prior to 1996, the year for which we can first obtain information about equity grants. We next drop 16,353 patents because the number of days between the mailing of the NOA and the mailing of the patent issuance notification is missing, negative, or greater than 365 days. Our initial sample includes 565,418 patents issued to 4,060 firms.

We match sample firms to Compustat to obtain financial statement information. We obtain CEO and director option grant information from the Thompson Reuters Insiders database. We identify CEOs as having any "rolecode" (1-4) as "CEO" and outside directors as having "rolecode" as "D" in that database. The option grant data are available starting in 1996.[10] We are

[8] Utility patents ("patents for invention") are the most commonly issued type of patent, and we restrict our attention to this type.

[9] We obtain this information from Reed Technology Information Services. We use the date the patent issuance notification was mailed rather than when it was announced in the *Official Gazette by* the USPTO, as the earlier date is a more conservative measure of the end of the private-event window.

[10] We obtain all acquisition (versus disposition) transactions from the Form 4 Table 2 filings. Form 4 contains insider activity, while Table 2 contains derivative transactions. We match the transaction date as reported on Form 4

able to match option grant data for CEOs to 294,285 patents issued to 2,652 firms over eleven years. The sample sizes in the univariate and regression analyses are smaller due to missing citation information and missing independent variables. Our univariate sample includes 283,674 observations, while the full sample used in the CEO regressions includes 283,057 observations.

3.2 Research design

To examine the relation between private information and option grants, we compare a firm's option-granting behavior when it has private information about the forthcoming issuance of a patent to its option-granting behavior when it does not have such information. To do so, we define both a private-event window (when the firm has received the NOA, prior to the public disclosure of the patent) and a non-event window (when the firm does not have this information).

We define the private-event window to be the 90 days after the issuance of the NOA. The USPTO allows firms three months after the receipt of an NOA to pay the required filing fee. For the observations for which we know the payment date, 75% of the payments are *received* by the USPTO within 91 days.[11] (The 95th percentile is 98 days.) Even so, there is considerable variation in the number of days it takes for the patent to be issued after the receipt of the payment. For the observations for which we have the payment date, the number of days for the patent to be issued after the USPTO receives payment ranges from 29 (20) days at the 25th (5th) percentile to 70

to the firm's stock price (from CRSP) on that date as an additional attempt to verify the option grant date. If options are granted with the strike price equal to the market price on that date, as was typical, then the exercise price reported in Form 4 should correspond to the market price. Aboody and Kasznik (2000) follow this technique to assess the option grant date for their study. For the 1,239,252 transactions for which we have both non-zero, non-missing exercise prices and market prices, the two prices match in 817,500 cases. The third of the sample (421,752) that does not match could be because (1) the insider reported the incorrect date or exercise price or (2) Thomson picks up an incorrect date or exercise price. However, 34% of those observations are within 1% of each other and 72% are within 5%, suggesting that the differences, and thus the errors in the estimated timing of grants, may not be too great. Furthermore, we have no reason to believe that any errors are systematically biased.

[11] Our dates are based on when the USPTO receives the payment, which does not perfectly reflect the date the payment was mailed. This likely explains the fact that the payment period sometimes is greater than 93 days, the maximum of any three-month period. The three-month payment period is consistent with the test sample examined by Crouch (2010), who finds that a majority of sample NOA recipients waited to make payment until the week before the payment deadline.

(159) days at the 75th (95th) percentile. Given the variation in the length of time between a firm's payment and the patent issuance by the USPTO, the length of the window where the firm can expect to have private information after making the required payment is uncertain and largely out of the CEO's control. This suggests that the private information window that CEOs can control is the time period from when the NOA is received until when the payment is sent.[12]

We define the non-event window as the same window in the prior year (i.e., the same date the NOA was received, but in the prior year, through 90 days). While other potential non-event windows exist, such as the period just prior to the receipt of the NOA, seasonality in both option grants and NOAs complicates the selection of benchmarks. When we examine option grants and NOAs by month, we find systematic seasonality in both option-granting and NOA-issuance behavior. Specifically, we find that options are granted most frequently in December, January, and February, while NOAs are most frequently issued in March and least frequently in December, January, and February. This option-granting pattern is not specific to our patent sample (see Aboody and Kasznik, 2000, for example), suggesting that the seasonality in option grants is not induced by the NOA seasonality. Thus, if we use the 90-day window just prior to the NOA as a benchmark, the seasonal effects will affect the relation between option grants and NOA issuance. Consequently, we focus on the prior year non-event window.

An additional advantage of using the same period in the prior year as our benchmark is that it helps to control for certain other firm-specific events that might take place during the private-event window. In particular, systematic annual events such as earnings announcements are likely to occur at similar times in successive years. Since our windows are 90 days long, we

[12] In robustness tests, we also consider the 30-day period immediately before the patent is issued and the entire period between when the NOA is mailed to the patent applicant and the date the patent is issued – i.e., the entire time the private information is available to the firm. Our results using these alternative private-event windows are substantively similar.

expect to have either a quarterly or annual earnings announcement in most event and non-event windows. Since the evidence in prior work suggests that option grants may be timed around earnings news, the use of a benchmark that is likely to include the same type of information event helps to mitigate concerns that differential event-window grants are due to the occurrence of an earnings announcement.

Our hypotheses presume that there is no public disclosure of the patent information before the patent is issued. While prior research (Lansford 2006) suggests that firms tend not to disclose the receipt of an NOA, we examine our sample to see if this finding holds. We search all Form 8-Ks for our sample firms over our sample period to determine if there are any announcements of the NOAs. Of our original sample of 4,258 unique firms for which we can obtain a CIK to search the SEC EDGAR database, we are able to locate 8-K filings for 3,702 firms. We search their 176,232 8-K filings in this period and find that in only 92 of them is there any mention of the term "Notice of Allowance," overlapping with 112 private-event windows. This lack of discussion of NOAs reinforces our assumption that the private-event window does contain private information.

During our sample period, the possibility of earlier release of patent information by the USPTO changed. Prior to the American Inventors Protection Act of 1999 (AIPA), outside observers had no information about a firm's patent application or NOA until a patent was issued unless the firm itself disclosed patent information. One provision of the AIPA was that, subject to a few exceptions, the USPTO was required to publish all patent applications 18 months after the application was filed, if the patent had not already been issued. This provision applies to patent applications filed after November 29, 2000. While there remains uncertainty about the patent and the claims that might eventually be granted, the USPTO's publication of the filed

application has the potential to reduce the amount of private information available to a firm that receives an NOA. Thus, in some of our analyses below, we separately consider observations before and after the enactment of the AIPA, as well as post-AIPA observations where the NOA precedes the 18-month publication of patent application and those where the NOA is mailed subsequent to publication.

We use a multivariate setting to assess whether a firm's stock option-granting behavior is atypical during the private-event window, estimating the following cross-sectional model:

$$\begin{aligned} \text{LN\_\#OPT or POPT} = {} & \beta_0 + \beta_1 \text{WINDOW} + \beta_2 \text{MEAN\_ADJ\_CITE} + \beta_3 \text{RD\_SALES} \\ & + \beta_4 \text{WINDOW} \times \text{CITE} + \beta_5 \text{WINDOW} \times \text{RD} + \beta_6 \text{LNASSETS} \\ & + \beta_7 \text{BTM} + \beta_8 \text{PATENTCOUNT} + \beta_i \text{IND} + \beta_y \text{YEAR} + \varepsilon \end{aligned}$$

Where:

LN_#OPT	= Natural log of number of options (+1) granted during the window, where the window is either the private-event window or the non-event window.
POPT	= Indicator variable that equals 1 when options are granted to a CEO during the window (where the window is either the private-event window or the non-event window), and 0 otherwise.
WINDOW	= Indicator variable to capture the private-event window. Equals 1 if the window is the private-event window and 0 if it is the non-event window, defined as the same dates in the prior year.
MEAN_ADJ_CITE	= Citation count for the patent (adjusted for truncations using the Hall et al. 2001 method) less the average citation count for patents in the same Hall et al. tech category issued in the same year, winsorized.
RD_SALES	= R&D expenses, scaled by sales in year t-1 (where year t is the year the NOA is received), winsorized (de-meaned).
WINDOW × CITE	= Interaction of WINDOW and MEAN_ADJ_CITE.
WINDOW × RD	= Interaction of WINDOW and de-meaned RD_SALES.
LNASSET	= Natural log of assets in year t-1.
BTM	= Book value of assets scaled by market value of equity in year t-1, winsorized.

PATENTCOUNT	= The number of patents received by the firm during the sample period 1996 – 2006, scaled by the number of years the firm appears in the sample.
IND	= Industry fixed effects (based on the Fama French 12 classification).
YEAR	= Year fixed effects.

We run our tests using two dependent variables, *LN_#OPT* and *POPT*, to allow for differences in option-granting behavior across firms. For firms that grant options on a fixed schedule, private information would likely be exploited by an increase in the number of options granted, while firms with a more variable grant schedule might be more likely to make an additional grant.

Our main explanatory variables of interest are *WINDOW*, *WINDOW × CITE*, and *WINDOW × RD*. If firms grant more options during the private-event window relative to the non-event window, we predict a positive coefficient on *WINDOW*.[13] Similarly, if firms grant more options when they receive more valuable patents or when innovation is more important, we expect positive coefficients on *MEAN_ADJ_CITE* and *RD_SALES*. *MEAN_ADJ_CITE* captures the value of the patent about to be issued.[14] Consistent with prior work (e.g., Schmookler 1996; Trajtenberg 1990; Hall et al. 2005; Gu 2005; Plumlee et al. 2015), we use this ex-post measure of

[13] We de-mean the research and development variable in the regressions to aid in the interpretation of the coefficient on *WINDOW*. With the adjustment, this coefficient captures the incremental options granted during the private-event window relative to the non-event window for an observation with mean sample *RD_SALES* and average citation count for the patent technology category and age.

[14] Our use of citation count as a measure of the economic value of cited patents follows from prior work that shows that citation count is positively associated with future earnings and market values (Schmookler 1996; Trajtenberg 1990; Hall et al. 2005; Gu 2005). We begin with the citation count for our sample patents using patent citation data updated as of the end of 2006, the most recent year available, and adjust this count for patent age and technology subcategory using the factor based on Hall et al. (2001). The adjustment for the patent age helps to control for differences in citation counts arising from the time it takes for others to learn about and cite a patent. While citation counts of any patent are truncated in time since researchers only observe the citations received to date, newer patents are more likely affected by the truncation than older patents. In addition, patents in some categories (e.g., computer, drug, and medical) are cited more often than those in other categories, although they are not necessarily more valuable (Hall et al., 2001). We follow prior research and scale the adjusted citation count for each patent by the mean number of citations for all patents issued in the same technology category on a year-by-year basis (Gu, 2005; Plumlee et al. 2015). This fixed-effect approach is designed to mitigate cross-sectional differences in citation counts that are due to systematic differences in citation propensity over time and across technological categories.

patent value, which implicitly assumes that the ex-post value of the patent is apparent when the NOA is issued. *RD_SALES* captures the intensity with which firms invest in innovation. We interact both *MEAN_ADJ_CITE* and *RD_SALES* with *WINDOW*. If the effects of private information on option-granting behavior are greater for patents that are more valuable or when firms rely more on innovation, we expect positive coefficients on *WINDOW*×*CITE* and *WINDOW*×*RD_SALES*.

We control for firm size (*LNASSET*) and growth opportunities (*BTM*), to the extent these firm characteristics are associated with option-granting behavior. We also control for the average number of patents received by the firm each year during our sample period (*PATENTCOUNT*). If firms receive many patents, we expect they might be less likely to exploit private information in any one patent's private-event window. Finally, we include industry and year fixed effects to control for differences in option grants across industries and during different macroeconomic periods. We estimate the *LN_#OPT* model using OLS and compute standard errors cluster-adjusted by GVKEY to address potential cross-correlation within the firm. We use probit estimation for the *POPT* model.

Our regression model includes two observations for each patent: one observation using option-grant data drawn from the private-event window and one observation drawn from a non-event window of the same length. The independent variables are the same for each patent as the timing of the variables' measurement, when relevant, is based on the year the NOA is issued.

4. Results

4.1 Descriptive statistics

Table 1 provides descriptive statistics for our samples. Panels A and B include statistics about the patent issuances, including the number of patents issued per year, the frequency with

which they are cited, and the length of time between the receipt of an NOA and the issuance of a patent. Panel A includes statistics related to the full sample – 565,418 patents issued to a total of 4,060 firms. Panel B includes analogous statistics for the subsample of patents for which we also have the necessary CEO and Compustat data for our regression models – 294,285 patents issued to 2,651 firms.

In Panel A we find that the total number of patents issued each year varies from a low of 36,426 in 1997 to a high of 61,469 in 2003. These patents are issued to approximately 1,300 – 1,700 unique firms each year. Across this period, the mean (median) number of patents received per firm is 139 (6). In the full patent sample, 765 firms received only one patent throughout the eleven-year period, while 161 firms received in excess of 500 patents during that time period. As noted earlier, when a firm receives a large number of patents in a given year, it can make it difficult to isolate a non-event window to use as a benchmark. Thus we analyze subsamples in an effort to reduce the effects of this potential overlap in windows. The mean (median) number of days between when an NOA is issued and the related patent is issued is 142 (129) days. (We restrict the sample to observations where the period of time between the issuance of the NOA and the related patent is 365 days or less.)

Panel B of Table 1 presents analogous descriptive statistics to those presented in Panel A, but for the subset of patents for which we also have firm-level financial (Compustat) and option-granting (CEO) data. The reported values are consistent with the values reported in Panel A, although the number of firms for which we have all the necessary financial and option data is 2,651 rather than the 4,060 included in Panel A.

In Panel C we present descriptive statistics about the firms in our sample. The data in this panel include the firm-level variables used in our multivariate analyses. We document that the

mean (median) *RD_SALES* is 0.32 (0.07), consistent with some firms making significant investments in innovation. The sample includes larger firms (mean assets are $5 billion) and firms typically classified as growth firms (mean *BTM* is 0.55). As we documented in Panels A and B, the average number of patents issued to a single company within a year varies a great deal. Mean (median) *PATENTCOUNT* is 32 (5). This value is 1 (118) at the 5th percentile (95th percentile).

Panel D presents descriptive statistics about the sample patents. We compute abnormal returns to the USPTO's announcement of the patent issuance, *ANNC_ABN_RET*, as a three-day abnormal return, using the market model with value-weighted returns excluding dividends for market returns.[15] We estimate the model for 255 days prior to Day -46 (where Day 0 is the day the patent announcement is made) and require at least ten days of returns in our estimation window. *ANNC_ABN_RET* has a mean and median of 0.00. These numbers are similar to the mean (0.007) and median (-0.009) announcement returns found by Kogan et al. (2015). *POSCAR*, an indicator for positive abnormal announcement return, shows there was a positive response to 49% of the patent announcements. We include a citation count, *MEAN_ADJ_CITE*, in our multivariate analysis to control for differences in the expected value of patents. *MEAN_ADJ_CITE* is based on the number of citations for a given patent, adjusted for patent age and technology subcategory and has a mean (median) of 1.1 (-3.2) in our sample. Negative values indicate that a given patent received fewer citations than other patents of similar age and technology. For about half the patents in the sample, we have specific data about the number of days between the firm's receipt of an NOA and its payment of the fee required for the patent to be formally issued (Days to Pay) and the number of days between the firm's payment of the fee

[15] Exclusion of dividends helps to ensure that the change in market returns is not due a concurrent distribution of dividends rather than the event we are studying.

required and the issuance of the patent (Days to Issue). There is clearly variation in the timing of these payments and in the subsequent time it takes for the patent to be issued. While some firms choose to make the required payment quite quickly (the 5th percentile is 14 days), both the mean and median Days to Pay exceed 70 (the mean is 71.57 and median 79.00). Since the payment must be made within 90 days, the high mean and median suggest that a large proportion of firms delay payment, thereby increasing the length of their private information period. From the USPTO data, we see that some patents are issued soon after the payment is received (the 5th percentile is 39 days), but a substantial amount of time might pass before the patent is issued, even after the firm remits the payment (the mean number of Days to Issue is 79.95 days).

Panel E of Table 1 provides an industry breakdown (using the Fama-French 12 industry classification) for both the patents included in our analysis and the firms that received those patents. The Business Equipment industry receives the largest percentage of patents in our sample (161,558 patents – 57.0%) and firms within the Business Equipment industry make up the greatest proportion of the sample firms (806 firms – 34.6%). Our sample also includes many patents in the Manufacturing (41,985 – 14.8%) and the Healthcare/Medical (29,690 – 10.5%) industries, with the firms in those industries making up 15.7% and 21.7%, respectively, of the sample firms. Interestingly, we find that patents are issued across all 12 Fama-French industries, although they are relatively infrequent in some industries (e.g., Utilities and Wholesale/Retail).

4.2 Univariate analyses

Table 2 presents mean and median statistics related to the firms' option-granting behavior during the private-event window and the non-event window. We examine two types of option-granting behavior: (1) the number of options granted during the window *(#OPT*) and (2) whether any options were granted during the window (*POPT*). We present several sets of results

throughout our study: results based on the full sample and on subsamples where we might expect our tests to have more power to detect an effect. As discussed earlier, the frequency with which some firms receive patents and the length of the private-event window can make it difficult to identify a non-event window for a given NOA that does not overlap with a private-event window for another NOA. Thus our first subsample (No Conflict) limits the analysis to observations with no NOAs issued to the firm during the benchmark period. We start with all patent issuances in the NBER dataset for which we can determine their NOA date (762,483 patents). Then for each patent, we determine whether the firm received any other NOA from a different patent in the benchmark period. If, for a particular patent, the firm does receive a NOA in the benchmark period for another patent, that patent is deemed to have a conflict and is eliminated from the sample. For our sample of 283,674 patents, we isolate 11,087 that are unconflicted.

The second subsample (Variable Granter) includes only firms with option grant dates that appear not to follow a fixed schedule, based on a method similar to the one used in Aboody and Kasznik (2000). They define an option grant as being fixed if the grant made in the current year is within one week of an option grant in the prior year. We follow this procedure and first define individual option grants as fixed if an option grant was also made within five days of the grant date but in the prior fiscal year. Then we classify the *firm* as a variable granter if fewer than 50 percent of option grants made during the fiscal year are classified as fixed.[16] We classify firms, rather than individual grants, because we are identifying behavior over significantly longer windows than Aboody and Kasznik (2000). This sample includes 172,397 observations.

[16] For example, assume a firm grants options three times during the year. If two of those were within five days of the same date last year, this firm would be classified as a "fixed" granter since two thirds of the grants appear to be made on a fixed date. If only one of those were within five days of the same date last year, then that firm would be classified as a "variable" granter and included in the analyses. The assumption behind this test is that variable granters have more flexibility in timing their grants.

Our third subsample (Positive Annc. Return) is limited to the set of observations where the firm's stock price reacts positively to the USPTO's public announcement of the issuance of the patent and includes 132,931 observations. The fourth subsample (Top Ten %) includes only highly cited patents—those for which the adjusted citations are in the top decile of all patents.

We also partition the sample into the pre- and post-AIPA time periods. Recall that following the implementation of the AIPA, the USPTO publishes patent applications 18 months after the application was filed, potentially reducing the private information available to the firm upon receipt of an NOA. To control for USPTO publication of the application, we further partition the post-AIPA period according to the timing of the NOA. Patents for which the NOA was received earlier than 18 months after the application was filed (Post AIPA ≤18 months) were not preempted by USPTO publication, so the NOA information is still private when it is received. In contrast, some information has been disclosed about patents for which the NOA was received after the USPTO publication of the application (Post AIPA >18 months).[17]

Panel A of Table 2 presents the mean number of the options granted within the private-event and non-event windows for the full sample, as well as for the subsamples discussed above. In Panel B, we present the probability that options are granted during the private-event and non-event windows for the full sample and the subsamples. In each panel, we present t-statistics from tests of differences between the number/probability of options granted in the private-event window and the non-event window. Positive t-statistics are consistent with a greater number of options granted (Panel A) or a higher likelihood of granting options (Panel B) when firms possess private information.

[17] The number of observations in the Post AIPA ≤ 18 months and Post AIPA >18 months subsamples do not add up to the total in the Post AIPA subsample because we do not have application filing dates for all patents.

Across both panels, we find that firms' option-granting behavior within the private-event window is significantly different from the non-event window: both the number of options granted and the probability of an option grant are significantly greater during the private-event window than during the non-event window. This finding holds for the full sample as well as most of the subsamples. In the No Conflict sample and the Variable Granter sample, option grants are significantly greater in the private-event window, but the likelihood of option grants is not significantly different. The lack of significance in the No Conflict sample may be attributable to the considerably smaller sample size in this subsample. The other subsample where there is no significant difference in option-granting behavior is the Post AIPA>18 months group. Since this is the group of firms where the private information revealed by the NOA may be pre-empted by the USPTO's publication of the patent application, this finding suggests that the amount of private information in the NOA affects option-granting behavior.

4.3 Regression analyses

We estimate the regression model above using two dependent variables: the log of the number of options granted (*LN_#OPT*) and an indicator variable that equals one if any options were granted (*POPT*). Table 3 Panel A presents results when *LN_#OPT* is the dependent variable, and Panel B presents results when *POPT* is the dependent variable. Within each panel, we report results of the model estimation based on the full sample and the four subsamples—firms with no conflicting NOAs issued during the benchmark window, variable granters, observations with a positive announcement return at the time the patent is publicly disclosed by the USPTO, and the top 10% most highly cited patents. In the regressions using the positive announcement return and highly cited (Top Ten %) subsamples, we omit the citations variable

and its interaction, since we expect these subsamples already to include patents perceived as more valuable.

In three of the five columns in Table 3 Panel A, we document that the coefficient on *WINDOW* is positive, consistent with more options being granted during the period when a firm possesses private information about an NOA than during the same 90 days in the prior year. Recall that both *RD_SALES* and *MEAN_ADJ_CITE* are mean-adjusted variables, so the coefficient on *WINDOW* captures the options granted during the private-event window relative to the non-event window for an observation with mean R&D to sales and average citations for patent age and technology class. For example, in the full sample, the coefficient on *WINDOW* is 0.132, which indicates that 14% more options were granted during the private-event window than the non-event window.[18] Consistent with firms that rely more on innovation granting more options, *RD_SALES* is significantly positive in the full sample and the set of patents with positive abnormal announcement returns. We find a strong positive coefficient on the interaction between *RD_SALES* and *WINDOW* in all samples except the No Conflict subsample. This finding suggests that when firms possess private information about a forthcoming patent, they grant CEOs more options as their reliance on innovation increases. We also include the (adjusted) number of citations a patent receives subsequent to issuance (*MEAN_ADJ_CITE*) and an interaction between this variable and *WINDOW* as explanatory variables in the first three columns. These variables are generally not significant in our analysis, with the exception of *WINDOW*×*CITE* in the No Conflict subsample.[19] The positive coefficient on *WINDOW*×*CITE* indicates that more options are granted in the private-event window, relative to the benchmark,

[18] $e^{0.132} = 1.14$, indicating that the number of options granted during the private-event window is 114% of the number granted during the non-event window.

[19] The No Conflict subsample differs somewhat from the rest of the sample. In addition to receiving far fewer patents, firms in this group are smaller and grant fewer options to their CEO but have higher values of RD_SALES.

when the patent's future citations are greater. In sum, these results suggest that (1) more options are granted during the private-event period relative to the same period in the prior year, as well as when firms rely on innovation, (2) even more options are granted when a firm that relies on innovation has private information, and (3) there is some evidence that more options are granted when a firm has private information about a more valuable patent.

Panel B of Table 3 presents results of probit regressions analogous to those in Panel A, where the dependent variable is an indicator for whether options are granted during the window. The findings in Panel B are similar to those in Panel A. We again find a positive coefficient on *WINDOW* for the full sample, as well as the positive announcement return and highly cited patent subsamples. As in the earlier regressions, the coefficients on *WINDOW*×*RD* are positive in four of the columns, suggesting that the likelihood that options are granted to the CEO during the private-event window relative to the benchmark window increases as the importance of innovation increases. Similarly, the positive coefficient on *WINDOW*×*CITE* in the No Conflict subsample indicates that an NOA for a more valuable forthcoming patent is associated with a greater likelihood of options granted to the CEO when the firm has private information, relative to the prior year benchmark.

Both panels of Table 3 also include control variables. As expected, firm size (*LNASSETS*) has a significantly positive association with the number of options granted and likelihood of option grants in all regressions, while *BTM*, an inverse measure of growth opportunities, is generally negatively associated with the number of options granted. Interestingly, the coefficient on the average number of patents issued to the firm each year over the sample period (*PATENTCOUNT*) is significantly negative, suggesting that CEOs of firms that receive more patents per year are granted fewer options, all else equal.

We conduct (but do not tabulate) several additional analyses for robustness and to explore other aspects of the patent setting. First, as discussed earlier, the large number of NOAs received by many of the sample firms complicates the definition of a benchmark non-event window. While our Table 2 and Table 3 subsample analyses are intended to help address this issue, we rerun the analysis excluding the ten firms who received the greatest number of patents throughout our sample period and find similar, but slightly stronger, results.[20] Second, in some cases, sample firms receive more than one NOA on a single day. We aggregate NOAs received by a firm on the same day to form a single observation with the firm characteristics. We set *MEAN_ADJ_CITE* for the observation to the highest adjusted citation count of the patents received that day, since we expect the most valuable patent to determine option-granting behavior. The results from this test are similar to those shown in Table 3.

We also consider insiders' open market share purchases as an alternate means of exploiting the information in the NOA. Using CEO open market purchases and sales from Thomson Reuters, we create indicators for whether the CEO was a net purchaser (number of shares purchased during the period exceeded the number of shares sold) during the private-event window, the prior year non-event window, and the 90-day (non-event) window preceding the NOA, and run similar regressions that compare the private-event window to each non-event window. We find no evidence of increased insider purchases during the private-event window relative to the prior year non-event window or the 90 days preceding the private-event window for the full sample or any of the subsamples. Our different findings for option grants and insider purchases are similar to the results in Rogers and Stocken (2005) and may reflect a reluctance by insiders to engage in opportunistic trading behavior that might be detected.

Finally, we examine differences between the firms that appear to grant more options in

[20] Dropping these ten firms reduces the number of patents from 283,674 to 181,824.

the private-event window and firms that do not. We identify 152,513 days that firms receive one or more NOAs (using the maximum *MEAN_ADJ_CITE* from the NOAs received on that day as the firm-level citation count when there is more than one). We then classify firms as either granting more options in the private-event window relative to the same period in the prior year or fewer options relative to the prior year. Firms that grant in neither period are excluded. In untabulated univariate analysis, we find that firms granting more options in the private-event window (1) rely more on innovation (have higher levels of *RD_SALES*), (2) are smaller, (3) have lower BTM (higher growth), (4) receive fewer patents per year, and (5) are more likely to grant options on a fixed schedule than the other firms. Furthermore, the NOAs received by those firms relate to patents that are more highly cited.

4.4 Additional regression analyses

As discussed above, the AIPA may have reduced the amount of private information available to some firms at the time an NOA is received. We explore the effect of this change in patent law by partitioning the sample according to whether the AIPA was in effect (filing dates after November 29, 2000) and likely required the publication of the patent application (NOAs issued more than 18 months after the filing date).[21] Table 4 presents the results. Given the similar findings for our two dependent variables in Table 3, we provide only regressions using the log of the number of options granted as the dependent variable. In the first column, we repeat the full sample results from Table 3 for comparison. The second and third columns present results for the pre-AIPA and post-AIPA periods, respectively. Consistent with the results for the full sample,

[21] The AIPA does not require publication of the patent application if the applicant does not file for a foreign patent on the same invention. We do not have data about whether applicants have also filed for a patent in a foreign country.

the coefficient on *WINDOW* in the pre-AIPA period is significantly positive. In contrast, the coefficient on *WINDOW* in the post-AIPA period is insignificantly different from zero. The coefficients in the two samples are significantly different (p-value = 0.06).

We further partition the post-AIPA sample into observations where the NOA is received before the 18-month date of USPTO publication of the patent application and those where the NOA is received more than 18 months after the patent application was filed. When the NOA is received before the USPTO has the opportunity to publish the patent application (Post AIPA ≤ 18 months) the coefficient on *WINDOW* is significantly positive, while the coefficient on *WINDOW* is insignificantly different from zero for the Post AIPA > 18 months sample. The coefficients are significantly different at the 1.1% level. Collectively, the results in Table 4 suggest that more options are granted after an NOA is received when the private information is less likely to have been preempted by the USPTO's publication of the patent application.

Our final analysis explores the difference in option grants to two types of firm insiders—outside directors and CEOs—following the receipt of an NOA. If the private patent-related information is simply used to grant options that have greater value to the recipient, we expect that both boards and executives might see increases in option grants in the private-event window relative to the benchmark. However, if option grants are used to reward CEOs for performance when a firm learns that a patent is forthcoming, we expect to see a greater increase in options granted during the private-event window for CEOs than for outside directors. We present univariate results related to the firms' option-granting behavior to outside directors during the private-event window and the non-event window in Table 5. Table 6 presents the results from a regression of the number of options granted to outside directors on the indicator for the private-event window and other explanatory variables.

Similar to the CEO results presented in Table 2, Table 5 suggests that outside directors receive larger option grants during the private-event window than during the non-event window. For the full sample and two subsamples (No Conflict and Top Ten %), the average number of options (*D_#OPTIONS*) granted to outside directors when a firm possesses private information is significantly larger than when it does not. We also document that, within the two subsamples, firms more frequently grant options to outside directors during the private-event period than the non-event period. For the full sample, we find the opposite about grant frequency – firms more frequently grant options to outside directors during the non-event window than during the private-event window.

Table 6 presents our multivariate results for both CEOs and outside directors based on the full sample and the No Conflict and Top Ten % subsamples. In this table, we limit the sample to firms for which we have both CEO and outside director data. In general, we find positive coefficients on *WINDOW×RD*, indicating that both CEOs and outside directors receive larger option grants when a firm has patent-related private information and it relies more on innovation. In contrast, only one type of firm insider – CEOs – receives larger option grants during the private-event window across the full sample of patents. When we limit the sample to more valuable patents (Top Ten %), we find that both CEOs and outside directors receive larger options grants during the private-event window, although the percentage increase is larger for CEOs. Within the No Conflict subsample, we provide weak evidence that CEOs receive larger option grants when a firm has patent-related private information for more valuable patents (in the CEO regression the coefficient on *WINDOW_CITE* is positive with a t-statistic of 1.90). This is not true for outside directors.

In sum, the results in Table 6 suggest that all insiders benefit when a firm that relies on innovation receives private information about a forthcoming patent. In contrast, only CEOs benefit from the presence of private information in general, and CEOs benefit more than outside directors when private information is more valuable. One interpretation of these findings is that option grants to CEOs following the receipt of an NOA are, at least partially, used to reward CEOs for performance.

5. Conclusions

We examine whether firms' option-granting behavior differs when they possess private information related to the future receipt of a patent. Our study provides evidence that firms exploit this positive private information by granting more options or increasing the likelihood of granting options, relative to a prior year non-event window. Using a multivariate framework, we find that option grants in the private-event window are increasing in R&D, suggesting that firms exploit the private information more when innovation is more important to the firm. We also provide some evidence that, when firms' private information is related to patents that are likely more valuable, the number of options granted during the private-event window is greater and the probability that an option grant will take place increases.

In additional analysis, we examine differences in option-granting behavior before and after a change in patent law that requires the USPTO to publish patent applications 18 months after the application was filed and between CEOs and outside directors. The results suggest that firms provide larger option grants and are more likely to grant options when the private information is not preempted by the USPTO public disclosures. Furthermore, CEOs appear to benefit broadly from the presence of private information, while other insiders appear to benefit from private information most in firms with a greater reliance on innovation. The results provide

support for the hypothesis that firms use private information to grant stock options with greater upside potential to CEOs.

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APPENDIX A

Variable Definitions

Variables	Descriptions
LN_#OPT	Natural log of number of options (+1) granted to the CEO during the window, where the window is either the private-event window or the non-event window.
POPT	Indicator variable that equals one when options are granted to a CEO during the window (where the window is either the private-event window or the non-event window), and zero otherwise.
D_#OPTIONS	Natural log of number of average number of options (+1) granted to outside directors during the window, where the window is either the private-event window or the non-event window.
D_POPT	Indicator variable that equals one when options are granted to outside directors during the window (where the window is either the private-event window or the non-event window), and zero otherwise.
POSCAR	Indicator variable that equals one if the announcement period abnormal return is greater than zero, and zero otherwise.
WINDOW	Indicator variable to capture the private-event window. Equals one if the window is the private-event window and zero if it is the non-event window, defined as the same dates in the prior year.
ANNC_ABN_RET	Three-day abnormal return, using the market model with value-weighted returns excluding dividends for market returns. We estimate the model for 255 days prior to Day -46 (where Day 0 is the day the patent announcement is made) and require at least ten days of returns in our estimation window.
MEAN_ADJ_CITE	Citation count for the patent (adjusted for truncations using the HJT method), less the average citation count for patents in the same HJT tech category issued in the same year, winsorized.
RD_SALES	R&D expenses, scaled by sales in year t-1 (where year t is the year the NOA is received), winsorized (de-meaned).
WINDOW×CITE	Interaction of WINDOW and MEAN_ADJ_CITE.
WINDOW×RD	Interaction of WINDOW and de-meaned RD_SALES.
LNASSET	Natural log of assets in year t-1.
BTM	The book value of assets scaled by the market value of equity, in year t-1, winsorized.
PATENTCOUNT	The number of patents received by the firm during the sample period 1996-2006, scaled by the number of years the firm is in the sample.
IND	Industry fixed effects (based on the Fama French 12 classification).
YEAR	Year fixed effects.

Table 1
Descriptive statistics on patent issuances

Panel A: All patent data – 565,418 patents to 4,060 firms.

Year	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Total*
#Patent issued/ year[1]	36.8	36.4	48.4	51.1	54.0	60.2	61.4	61.4	59.3	48.5	47.9	565.4
# Firms receiving patents/year[1]	1.5	1.5	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.4	1.3	4.1

# Patents/Firm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11-20*	*21-50*	*51-100*	*101-200*	*201-500*	*>501*	*Mean/ Med*
# Firms	765	457	290	219	192	146	121	116	87	71	472	464	212	159	128	161	139 / 6

	Percentiles				
	Min	*25%*	*50%*	*Mean*	*75%*	*Max*
# Days between NOA and patent issuance	0	110	129	142	163	365

Panel B: Patent data with CEO and Compustat data – 294,285 patents issued to 2,651 firms.

Year	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Total*
#Patent issued/ year[1]	11.6	26.9	28.3	31.8	32.2	34.2	35.9	33.6	28.6	30.1	294.3
# Firms receiving patents/year[1]	0.8	1.2	1.1	1.1	1.2	1.2	1.2	1.1	1.0	1.0	2.7

# Patents/Firm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11-20*	*21-50*	*51-100*	*101-200*	*201-500*	*>501*	*Mean/ Med*
# Firms	352	264	175	129	138	102	88	83	65	48	343	361	171	126	103	103	128 / 8

	Percentiles					
	Min	*25%*	*50%*	*Mean*	*75%*	*Max*
# Days between NOA and patent issuance	0	106	127	140	162	365

Table 1 (continued)

Panel C: Firm characteristics for firms issued patents between 1996-2006

	N	Mean	Std. Dev.	5%	Median	95%
RD_SALES	10,180	0.315	0.617	0.000	0.072	2.367
LNASSETS	10,274	5.910	2.234	2.448	5.820	9.709
Assets (in millions)	10,274	4,999	37,351	12	337	16,467
BTM	10,202	0.547	0.282	0.125	0.526	1.088
PATENTCOUNT	10,308	31.8	129.3	1.0	5.0	118.3

Panel D: Patent descriptive statistics for patents issued between 1996 – 2006.

	N	Mean	Std. Dev.	5%	Median	95%
ANNC_ABN_RET	269,372	0.000	0.043	-0.069	0.000	0.072
POSCAR	269,372	0.493	0.500	0	0	1
MEAN_ADJ_CITE	283,674	1.110	19.831	-18.401	-3.203	38.766
Days to Pay	152,760	71.569	50.911	14	79	99
Days to Issue	152,579	79.952	48.968	39	63	183

Panel E: Fama-French Industry breakdown by patents and firms.

		By Patent		By Firm	
	Fama French Industry	N	% of N	N	% of N
1	Consumer Durables	3,613	1.27	100	4.29
2	Consumer Nondurables	10,575	3.73	95	4.08
3	Manufacturing	41,985	14.8	366	15.71
4	Energy	6,143	2.17	43	1.85
5	Chemicals & Allied Products	15,992	5.64	84	3.61
6	Business Equipment	161,558	56.96	806	34.61
7	Telecommunication	3,000	1.06	40	1.72
8	Utilities	49	0.02	18	0.77
9	Wholesale/Retail	428	0.15	70	3.01
10	Healthcare/Medical	29,690	10.47	505	21.68
11	Finance	634	0.22	50	2.15
12	Other	10,007	3.52	154	6.53
	Total	283,674		2,331	

[1] The number of patents and number of firms in Panels A and B are reported in 1,000s.

The table provides descriptive statistics for the sample. Panel A includes patent-related statistics based on the full set of patents for which we have detailed information about the date the NOA was mailed. Panel B includes analogous statistics for the set of patents for which we have the patent information as well as CEO and Compustat data required for our analysis. Panel C includes firm-level descriptive statistics for the firm years included in the full sample in the regression analysis. Panel D includes patent-level descriptive statistics for the same sample. Panel E provides industry data, based on both patents and firms.

Table 2
Univariate statistics – number and likelihood of option grants to CEOs within private-event and non-event windows.

Panel A: Mean number of options granted during private-event and non-event windows

Window	Full Sample	No Conflict	Variable Granter	Positive Annc. Returns	Top Ten %	Pre AIPA	Post AIPA	Post AIPA≤ 18 mths	Post AIPA >18 mths
Event - NOA	2.473	1.662	2.447	2.432	2.330	2.148	2.960	3.043	3.078
Non-event	2.341	1.580	2.399	2.312	2.131	1.981	2.880	2.731	3.079
t-stat	**(13.50)**	**(1.80)**	**(3.50)**	**(8.48)**	**(6.21)**	**(13.64)**	**(4.97)**	**(8.13)**	(-0.10)

Panel B: Likelihood of option grant during private-event and non-event windows.

Window	Full Sample	No Conflict	Variable Granter	Positive Annc. Returns	Top Ten %	Pre AIPA	Post AIPA	Post AIPA≤ 18 mths	Post-AIPA >18 mths
Event -NOA	0.202	0.146	0.197	0.198	0.189	0.176	0.245	0.245	0.248
Non-event	0.193	0.141	0.196	0.191	0.177	0.167	0.220	0.220	0.247
t-stat	**(10.56)**	(1.15)	(1.42)	**(6.31)**	**(4.73)**	**(9.45)**	**(5.22)**	**(8.12)**	(0.84)
# of Obs.	283,674	11,087	172,397	132,931	28,361	170,041	113,633	21,655	80,616

This table reports univariate analyses of option-granting behavior between the private-event (NOA) and non-event windows. Panel A reports the mean of the log of the number of options granted during each window. The t-statistic in parentheses indicates if the number of options granted in the private-event window is statistically different from number granted in the non-event window. Panel B reports the proportion of windows with option grants during the private-event and non-event windows. The t-statistic in parentheses indicates if the proportion of private-event windows with option grants is statistically different from the proportion of non-event windows with option grants. We present results based on the full sample of patents and several subsamples. No Conflict includes patents where there is no overlap within a firm in terms of private-event and non-event windows. Variable Granter includes patents issued to firms classified as variable option granters. Positive Annc. Returns are patents with positive announcement period abnormal returns. Top Ten % includes patents that fall within the top decile of *MEAN_ADJ_CITES*. Pre AIPA/Post AIPA includes patents that were filed prior/subsequent to the enactment of the AIPA. Post AIPA ≤ 18 mths and Post AIPA>18 mths include the subset of patents filed post-AIPA classified into those with an NOA issued less than 18 months after the application date and those with an NOA issued more than 18 months after the application date.

Table 3

Regression of the log of the number of options granted/proportion of option grants on an indicator variable for private-event window, proxies for the value of patents and importance of innovation for the firm, and control variables.

Panel A: Model with LN_#OPT as the dependent variable

$LN\_\#OPT = \beta_0 + \beta_1 WINDOW + \beta_2 MEAN\_ADJ\_CITE + \beta_3 RD\_SALES + \beta_4 WINDOW \times CITE + \beta_5 WINDOW \times RD + \beta_6 LNASSETS + \beta_7 BTM + \beta_8 PATENTCOUNT + \beta_i IND + \beta_y YEAR + \varepsilon$

Independent variables	Full Sample	Patent Sub-Sample			
		No Conflict	Variable Granter	Positive Annc. Returns	Top Ten %
WINDOW	**0.132*** **	0.0241	0.044	**0.122*** **	**0.200*** **
	(3.54)	(0.66)	(1.49)	**(2.76)**	**(3.92)**
MEAN_ADJ_CITE	0.000	-0.002	0.000	NA	NA
	(0.30)	(-0.87)	(0.12)		
RD_SALES	**0.385** **	-0.025	0.266	**0.362** **	0.073
	(2.47)	(-0.30)	(1.56)	**(2.24)**	(0.28)
WINDOW×CITE	0.000	**0.005** **	-0.000	NA	NA
	(0.00)	**(2.08)**	(-0.11)		
WINDOW×RD	**0.234*** **	0.106	**0.210*** **	**0.348*** **	**0.267** *
	(3.34)	(1.19)	**(2.96)**	**(3.92)**	**(1.93)**
LNASSETS	**0.242*** **	**0.152*** **	**0.154*** **	**0.260*** **	**0.241*** **
	(4.65)	**(5.01)**	**(2.53)**	**(4.97)**	**(3.19)**
BTM	**-0.470** *	**-0.306** **	**-0.724** **	-0.378	-0.418
	(-1.67)	**(-1.97)**	**(-2.27)**	(-1.31)	(-1.10)
PATENTCOUNT	**-0.001*** **	**-0.007** *	0.000	**-0.001*** **	**-0.001*** **
	(-3.57)	**(-1.72)**	(0.52)	**(-5.16)**	**(-3.46)**
Intercept	1.167	0.068	**2.398** **	0.063	0.268
	(1.21)	(0.14)	**(2.25)**	(0.06)	(0.27)
IND/YEAR controls	Yes	Yes	Yes	Yes	
# Observations	566,114	21,542	343,664	265,530	56,612
Adjusted R^2	3.03%	1.69%	2.67%	3.38%	3.81%

Panel B: Model with POPT as the dependent variable.

$POPT = \beta_0 + \beta_1 WINDOW + \beta_2 MEAN\_ADJ\_CITE + \beta_3 RD\_SALES + \beta_4 WINDOW \times CITE + \beta_5 WINDOW \times RD + \beta_6 LNASSETS + \beta_7 BTM + \beta_8 PATENTCOUNT + \beta_i IND + \beta_y YEAR + \varepsilon$

	Full	Patent Sub-Sample			
Independent variables	Sample	No Conflict	Variable Granter	Positive Annc. Returns	Top Ten %
WINDOW	**0.036***** **(2.63)**	0.007 (0.28)	0.005 (0.56)	**0.033**** **(2.33)**	**0.056***** **(3.01)**
MEAN_ADJ_CITE	-0.000 (-0.08)	-0.001 (-0.83)	-0.000 (-0.07)		
RD_SALES	**0.093*** **(1.81)**	-0.022 (-0.64)	0.062 (1.11)	0.088 (1.64)	-0.042 (-0.41)
WINDOW×CITE	-0.000 (-0.13)	**0.002** **(1.66)***	-0.000 (-0.28)		
WINDOW×RD	**0.072***** **(3.26)**	0.038 (1.10)	**0.065***** **(2.97)**	**0.101***** **(3.74)**	**0.102*** **(1.72)**
LNASSETS	**0.059***** **(3.50)**	**0.053***** **(4.47)**	**0.038**** **(2.01)**	**0.065***** **(3.85)**	**0.062**** **(2.38)**
BTM	**-0.138*** **(-1.68)**	**0.115*** **(-1.86)**	**-0.200**** **(-2.17)**	-0.112 (-1.33)	-0.117 (-1.03)
PATENTCOUNT	**-0.000***** **(-2.97)**	-0.003 (-1.28)	0.000 (0.38)	**-0.000***** **(4.32)**	**-0.000***** **(-2.50)**
Intercept	**-0.956***** **(-2.96)**	**-1.615***** **(-5.17)**	**-0.615*** **(-1.83)**	**-1.272***** **(-3.15)**	**1.274***** **(-3.56)**
IND/YEAR controls	Yes	Yes	Yes	Yes	Yes
# Observations	566,114	21,542	343,664	265,530	56,612

***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively. This table reports results from estimating Model 1 (Panel A) and Model 2 (Panel B) using the full sample and selected subsamples. Standard errors are cluster-adjusted for GVKEY. In Model 1, the dependent variable is log of the number of options granted in the window; in Model 2 the dependent variable is an indicator for whether options are granted in the window. WINDOW is an indicator to capture the private-event window (1) versus the non-event window (0). MEAN_ADJ_CITE is the mean citation count (adjusted for technology category and year). RD_SALES is lagged R&D to Sales (de-meaned). WINDOW×CITE (WINDOW×RD) is the interaction between WINDOW and MEAN_ADJ_CITE (WINDOW and de-meaned RD_SALES). LNASSETS is log of lagged assets. BTM is lagged book to market. PATENTCOUNT is the number of patents the firm received during our sample period, scaled by the number of years the firm is in the sample. No Conflict includes patents where there is no overlap of event and non-event windows with a firm. Variable Granter includes patents issued to firms classified as variable option granters. Positive Annc. Returns are patents with positive announcement period abnormal returns. Top Ten % includes patents that fall within the top decile of MEAN_ADJ_CITES.

Table 4
Regression of the log of the number of options granted on an indicator variable for private-event window, proxies for the value of patents and importance of innovation for the firm, and control variables.
Full sample and pre-/post-AIPA enactment time periods.

$$LN\_\#OPT = \beta_0 + \beta_1 WINDOW + \beta_2 MEAN\_ADJ\_CITE + \beta_3 RD\_SALES + \beta_4 WINDOW \times CITE + \beta_5 WINDOW \times RD + \beta_6 LNASSETS + \beta_7 BTM + \beta_8 PATENTCOUNT + \beta_i IND + \beta_y YEAR + \varepsilon$$

	Full	Sample sub-periods			
Independent variables	Sample	Pre AIPA	Post AIPA	Post AIPA ≤ 18 mths	Post AIPA > 18 mths
WINDOW	**0.132***** **(3.54)**	**0.167***** **(4.00)**	0.063 (1.22)	**0.311***** **(2.86)**	-0.003 (-0.05)
MEAN_ADJ_CITE	0.000 (0.30)	0.000 (0.05)	**0.003**** **(1.99)**	**0.005*** **(1.74)**	**0.004*** **(1.83)**
RD_SALES	**0.385**** **(2.47)**	0.238 (1.14)	**0.551***** **(3.57)**	**0.594**** **(2.54)**	**0.664***** **(3.56)**
WINDOW×CITE	0.000 (0.00)	0.000 (0.31)	-0.001 (-0.93)	-0.003 (-0.83)	-0.000 (-0.07)
WINDOW×RD	**0.234***** **(3.34)**	**0.233***** **(2.81)**	**0.246***** **(2.63)**	**0.553**** **(2.42)**	**0.205*** **(1.82)**
LNASSETS	**0.242***** **(4.65)**	**0.241***** **(3.67)**	**0.242***** **(4.78)**	**0.307***** **(4.50)**	**0.231***** **(4.13)**
BTM	**-0.470*** **(-1.67)**	**-0.608*** **(-1.76)**	-0.460 (-1.02)	-0.348 (-0.69)	-0.429 (-0.80)
PATENTCOUNT	**-0.001***** **(3.57)**	**-0.001***** **(4.01)**	**-0.001***** **(-2.65)**	**-0.001***** **(-2.74)**	**-0.001**** **(-2.20)**
Intercept	1.167 (1.21)	1.263 (1.10)	0.757 (1.17)	-0.187 (-0.25)	**1.223*** **(1.78)**
IND/YEAR controls	Yes	Yes	Yes	Yes	Yes
# Observations	566,114	339,274	226,840	43,240	160,948
Adjusted R^2	3.03%	3.14%	2.04%	2.58%	1.57%

***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively. This table reports results from estimating Model 1 using the full sample and select time periods. Standard errors are cluster-adjusted for GVKEY. The dependent variable is the log of the number of options granted in the window. WINDOW is an indicator to capture the private-event window (1) versus the non-event window (0). MEAN_ADJ_CITE is the mean citation count (adjusted for technology category and year). RD_SALES is lagged R&D to Sales (de-meaned). WINDOW×CITE (WINDOW×RD) is the interaction between WINDOW and MEAN_ADJ_CITE (WINDOW and de-meaned RD_SALES). LNASSETS is the log of the lagged assets. BTM is the lagged book to market. PATENTCOUNT is the number of patents the firm received during our sample period, scaled by the number of years the firm is in the sample. Pre AIPA/Post AIPA includes patents that were filed prior/subsequent to the enactment of the AIPA. Post AIPA ≤ 18 mths and Post AIPA>18 mths include the subset of patents filed post-AIPA classified into those with an NOA issued less than 18 months after the application date and those with an NOA issued more than 18 months after the application date.

Table 5
Univariate statistics
Number and likelihood of option grants to outside directors within private-event and non-event windows.

	Full Sample	No Conflict	Top Ten %
D_#OPTIONS in Event (NOA) Window	2.297	2.118	2.405
D_#OPTIONS in Non-event Window	2.273	1.951	2.288
t-stat	(3.37)	(4.12)	(5.09)
D_POPT in Event (NOA) Window	0.265	0.234	0.279
D_POPT in Non-event Window	0.267	0.218	0.273
t-stat	(-2.73)	(3.87)	(2.31)
# observations	270,452	10,644	26,699

The table presents univariate analyses of option-granting behavior to outside directors between the private-event (NOA) and non-event windows. We report the mean of the log of the number of options granted and the proportion of windows with option grants during each window. The t-statistic in parentheses indicates if the number (proportion) of options granted in the private-event window is statistically different from number (proportion) of options granted in the non-event window value. D_#OPTIONS is the average number of options granted to outside directors during a window. D_POPT is the proportion of the time that options are granted to outside directors during a window.

Table 6
Regression of number of options granted on an indicator for private-event window, proxies for the value of patents and importance of innovation for the firm, and control variables. CEO and Outside Directors.

$LN\_\#OPT = \beta_0 + \beta_1 WINDOW + \beta_2 MEAN\_ADJ\_CITE + \beta_3 RD\_SALES + \beta_4 WINDOW \times CITE + \beta_5 WINDOW \times RD + \beta_6 LNASSETS + \beta_7 BTM + \beta_8 PATENTCOUNT + \beta_i IND + \beta_y YEAR + \varepsilon$

	Full Sample		No Conflict		Top Ten %	
Independent variables	CEO	Outside Directors	CEO	Outside Directors	CEO	Outside Directors
WINDOW	**0.134*** **	0.022	0.050	0.099	**0.201*** **	**0.118** **
	(3.46)	(0.58)	(0.77)	(1.60)	**(3.87)**	**(2.39)**
MEAN_ADJ_CITE	0.000	-0.000	-0.001	0.001		
	(0.20)	(-0.21)	(-0.75)	(0.48)		
RD_SALES	**0.393*** **	0.135	-0.031	0.054	0.039	-0.334
	(2.49)	(0.96)	(-0.36)	(0.60)	(0.15)	(-1.55)
WINDOW×CITE	0.000	0.001	**0.004***	0.003		
	(0.16)	(1.35)	**(1.90)**	(1.42)		
WINDOW×RD	**0.236*** **	**0.280*** **	0.114	**0.254*** **	**0.303** **	**0.336*** **
	(3.32)	**(5.23)**	(1.27)	**(3.01)**	**(2.12)**	**(2.43)**
LNASSETS	**0.240*** **	**-0.121*** **	**0.150*** **	**0.107*** **	**0.237*** **	-0.100
	(4.47)	**(-2.56)**	**(4.81)**	**(3.52)**	**(3.05)**	(-1.55)
BTM	**-0.493***	-0.203	**-0.262***	**-0.368** **	-0.427	0.010
	(-1.74)	(-0.43)	**(-1.65)**	**(-2.24)**	(-1.10)	(0.02)
PATENTCOUNT	**-0.001*** **	0.000	**-0.006***	**-0.009*** **	**-0.001*** **	0.000
	(-3.64)	(1.21)	**(-1.71)**	**(-3.07)**	**(-3.43)**	(1.60)
Intercept	1.180	**1.585** **	0.039	0.868	0.290	**2.394***
	(1.20)	**(2.37)**	(0.08)	(1.36)	(0.29)	**(2.08)**
IND/YEAR controls	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	539,726	539,726	20,690	20,690	53,966	53,966
Adjusted R^2	3.28%	2.48%	1.72%	3.11%	3.91%	2.22%

***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively This table reports results from estimating Model 1 using the full sample and selected subsamples for both CEOs and outside directors. Standard errors are cluster-adjusted for GVKEY. The dependent variable is log of the number of options granted in the window. *WINDOW* is an indicator to capture the private-event window (1) versus the non-event window (0). *MEAN_ADJ_CITE* is the mean citation count (adjusted for technology category and year). RD_SALES is lagged R&D to Sales (de-meaned). WINDOW×CITE (WINDOW×RD) is the interaction between WINDOW and MEAN_ADJ_CITE (WINDOW and de-meaned RD_SALES). *LNASSETS* is the log of lagged assets. *BTM* is lagged book to market. *PATENTCOUNT* is the number of patents the firm received during our sample period, scaled by the number of years the firm is in the sample.