Mandated disclosure, institutional investors and stock price informativeness: Evidence from a quasi-natural experiment*

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ABSTRACT

We investigate the link between mandated disclosure and investor preferences using a regulatory change that required the disclosure of patent applications 18 months after filing. This change allows us to separate the disciplinary effect provided by disclosure from the information effect. Leveraging cross-sectional variation in exposure to the change, we find an increase in institutional ownership in the period prior to the information release, a reduction in blockholders' stakes, and an increase in trading by informed investors. Importantly, stock prices also become more informative. Our evidence implies that governance implications should be a central consideration for disclosure and reporting regulation.

KEYWORDS: institutional ownership, monitoring costs, innovation disclosure, corporate governance

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1. Introduction

There is a long-standing debate over the role of information disclosure in promoting financial market development and economic growth. Proponents refer to cross-country evidence that higher levels of investor protection, such as mandated disclosure, are associated with less concentrated ownership, larger equity markets, and higher valuations (La Porta, Lopez-de-Silanes, and Shleifer, 1999; La Porta, Lopez-De-Silanes, Shleifer, and Vishny, 1997, 1998, 2002). However, the exact channel and the direction of causality have been more difficult to establish. Mandated disclosure can provide benefits via at least two channels: (i) it can mitigate adverse selection problems and increase market liquidity by leveling the playing field among investors, and (ii) it can mitigate agency problems and reduce information gaps between firms and outside investors. While the role of the first channel has been widely investigated in the literature, little is known about the second channel (see the survey by Leuz and Wysocki, 2016).

This paper presents new evidence on the relationship between disclosure and institutional ownership. Theoretical models suggest that increased disclosure attracts institutional investors. Although the first empirical evaluations were published two decades ago (Healy, Hutton, and Palepu, 1999; Bushee and Noe, 2000; Ajinkya, Bhojraj, and Sengupta, 2005), the subsequent literature has failed to reach a consensus (Armstrong, Guay, and Weber, 2010; Beyer, Cohen, Lys, and Walther, 2010; Leuz and Wysocki, 2016). A natural concern is that most empirical studies on the link between corporate disclosure and institutional ownership are based on associations with firms' voluntary disclosure choices. This makes it difficult to interpret the underlying cause of the relationship. In particular, it remains unclear whether institutional investors gravitate to firms with particular disclosure qualities or induce changes in firms' information environment. Another potential explanation for the mixed evidence, particularly among studies that exploit changes in accounting standards or financial reporting requirements, is that the financial reporting system in most developed countries is already rich. Hence, the observed variation is incremental, and the economic consequences are difficult to establish (Leuz and Verrecchia, 2000).

We analyze a rare regulatory event that represents a regime shift that mandated the release of U.S. patent filings to the public domain. On November 29, 1999, Congress passed the American Inventors Protection Act of 1999 (Public Law 106-113; hereafter, AIPA), which required inventors filing for patents at the U.S. Patent and Trademark Office (USPTO) on or after

November 29, 2000 to publish their applications 18 months after filing. Before the enactment of the AIPA, patent applications were published at the time of the grant. Hence, the market had no information about applications that either failed to meet the USPTO's requirements for obtaining a patent or were withdrawn by the applicant. This regulatory change provides appealing features to study our research questions for the following reasons. First, the AIPA released otherwise private information about new technological developments to market participants, thereby increasing the disclosure environment in settings in which disclosure levels are rather low. Second, because firms did not change their regular disclosure levels around the enactment of the regulation, the 18-month regime shift allows us to separate the effect provided ex ante by mandated disclosure from the ex post effect when more information is available. This reduces the impact of confounding economic consequences of disclosure. Third, because industries differed in the time lag between patent applications and patent grants prior to the AIPA, we can adopt a difference-in-differences (hereafter, DiD) approach, which mitigates concerns regarding omitted time trends and reverse causality when examining the impact of mandated disclosure on institutional investors' behavior.

We hypothesize that mandated disclosure serves as a governance mechanism that disciplines managers by increasing the expected penalties for diversion from activities that increase shareholder value. Hence, it reduces the equilibrium level of diversion and, in turn, affects institutional investors by reducing the required level of costly monitoring. Consequently, the net profits from investing increase, so the amount of institutional ownership increases. In summary, mandated disclosure should increase institutional ownership. We build on the framework of financial markets developed in Shleifer and Wolfenzon (2002), who consider the case in which investor protection unexpectedly increases. Additionally, the theoretical lens adopted in Stulz (2009) suggests that mandated disclosure is value enhancing because the manager needs to commit on an ex ante basis, which reduces concerns about his/her private benefits or shrinking.[1]

In our baseline tests, we focus on variation in institutional ownership in the four quarters

[1]To fix ideas, consider managerial signaling motives before and after the enactment of the AIPA. Assume that the firm is run by a manager with unknown ability, as is standard in the career concerns literature. By definition, observable and verifiable information on patents and the controlled and certified way in which patents are obtained may serve as a signal of managerial ability (Long, 2002). Prior to the AIPA, the manager's effort (i.e., the number of submissions needed to obtain a successful patent) is not observable to outsiders, thereby providing incentives for overinvestment. By forcing patent applications to be disclosed, the AIPA reduces the benefits from engaging in costly signaling, thus mitigating the underlying inefficiencies. Moreover, the post-AIPA regime allows for better benchmarks against which managerial effort in innovation activities can be compared. This might influence institutional ownership through increased managerial effort. To be precise, the expectation that the information will eventually be disclosed is enough.

before and after the AIPA became effective. We focus on this period because it makes our empirical analyses less vulnerable to confounding effects stemming from the ex post impact of public information disclosure, as mentioned above. Central to our research strategy, the extent of patenting delays prior to the AIPA was not uniform across industries. While in some industries, for example, pharmaceuticals and biotechnology, the average time lag between patent applications and grant dates is 37.8 and 44.6 months, respectively; in other industries, such as electrical, this number is 26.5 months. These differences in pendency times across industries are observable and match well with the underlying evaluation complexity values assigned to them by the USPTO for determining examiner productivity goals (Popp, Juhl, and Johnson, 2003). We posit that the cross-sectional variation in patenting delays captures ex ante differences in the difficulty of monitoring firm management and assess how a change in monitoring costs impacts institutional ownership.

Our baseline DiD estimate indicates that a shock to monitoring costs due to mandated public innovation disclosure is associated with a significant and economically meaningful increase in institutional ownership in the four-quarter period following AIPA implementation relative to the four-quarter period preceding AIPA implementation for firms in complex industries compared to firms in miscellaneous industries. We further document that the increase in institutional ownership is concentrated in logical subsamples, such as among firms that are expected to file patents and firms with weaker internal or external monitoring. We also provide evidence in support of the parallel trends assumption underlying our DiD approach: the institutional ownership of our treatment firms and control firms only diverges after the AIPA became effective. Moreover, these results remain robust to using alternative treatment definitions, alternative pre- and posttreatment periods, the inclusion/exclusion of specific control variables, and several econometric models. We also confirm that our results are not explained away by the burst of the dot-com bubble and the economic recession that followed thereafter, the implementation of Regulation Fair Disclosure (Reg. FD), and decimalization. Overall, our identification tests suggest that mandated disclosure has a positive causal effect on institutional ownership.

We use several alternative dependent variables to provide additional evidence for the mechanism at work. First, we show that firms more affected by the AIPA experience a significant reduction in ownership concentration (proxied by the Herfindahl index) and an increase in ownership breadth (the fraction of institutional investors that own shares). Second, we follow the classification provided in Chen, Harford, and Li (2007) and examine whether there are different effects on different groups of institutions. Independent institutions specialize more in monitoring and influencing management decisions. Gray institutions will not monitor. We find that mandated disclosure through the AIPA has a positive and significant impact on ownership by independent institutional investors. However, we find no effect on gray investors' preferences. Third, if mandated disclosure decreases the costs of monitoring, we should also observe a reduction in the size of the stake held by blockholders. Our results reveal that the impact of the AIPA on blockholders' stakes is negative and that this effect becomes significant among the most liquid firms in which the costs of exit are lower. Taken together, these results are consistent with the idea that the benefits from ownership concentration decrease following a reduction in the difficulty of monitoring managers.

Finally, we examine the effect of AIPA implementation on stock price efficiency. Morck, Yeung, and Yu (2000) argue that better investor protection motivates investors to gather information on individual firms, and thus, prices reflect more firm-specific information. Jin and Myers (2006) make a similar prediction, arguing that when insiders extract less private rents, the stock price becomes more sensitive to firm-specific news. Following the literature, we use price non-synchronicity to proxy for the amount of firm-specific information in stock prices and reveal a positive relationship between mandated disclosure and price non-synchronicity in the post-AIPA period (but prior to the release of the information) for those firms most affected by mandated innovation-related disclosure.

Our findings contribute to several streams of literature. First, we add to the literature on disclosure and corporate governance by recognizing that mandated disclosure may feed back into corporate decision-making. To date, the empirical literature on the causal effects of mandated disclosure remains relatively scarce, and the analysis is limited to corporate investment choices (e.g., Leuz and Wysocki, 2016). Second, by examining the determinants of institutional ownership, our paper offers novel insights into a firm's governance structure and institutional investors' preferences. Our findings suggest that information asymmetries between firm insiders and investors are key for their capital allocation decisions and that mandated disclosure can mitigate the resulting agency conflicts. These considerations may be important for disclosure and reporting regulations and the current debate over whether and how the provision of more public information improves real efficiency (e.g., Goldstein and Yang, 2019). Finally, we contribute to the nascent stream of literature on the effects of the AIPA. While recent evidence documents private benefits stemming from increased innovation disclosure for firms that seek licensing revenues (Hegde and Hong, 2018), access to debt financing (Saidi and Žaldokas, 2020), and value capture in takeover markets (Chondrakis, Serrano, and Ziedonis, 2019), little is known about the broader implications of this landmark reform in equity markets. Equally important, our paper establishes improved governance as a new channel through which mandated innovation disclosure can affect economic outcomes.

2. Related literature and theoretical underpinnings

2.1. Literature review

The extant literature focuses on the effect of disclosure on information asymmetries among investors. The standard notion is that uninformed (or less informed) investors refrain from trading with their more informed counterparts, as they are concerned that informed investors are willing to sell (buy) at market prices only when the current price is too high (low). More informative public disclosure can mitigate adverse selection problems and increase market liquidity by making the playing field among investors more equal. Hence, disclosure might be beneficial to the firm because higher liquidity attracts investors and lowers the costs of capital (e.g., Easley and O'hara, 2004).[2]

In contrast, a number of papers have identified several channels through which enhanced disclosure can harm the firm. Of particular concern is that more information being disclosed to participants in financial markets can also provide useful information to competitors. Building on theoretical models such as Verrecchia (1983), several empirical studies provide support for the proprietary cost hypothesis, mainly by providing evidence of fewer segment disclosures due to competitive concerns. Other studies have focused on the private costs that managers bear from disclosing information to investors that contains bad news. For instance, Kothari, Shu, and Wysocki (2009) find that managers concerned about their careers delay the disclosure of bad news up to a certain threshold so that they can conceal bad news in good news disclosures. There is also substantial work suggesting that the risk of shareholder litigation increases the costs for managers and firms to provide disclosures, particularly when these are forward looking (e.g., Skinner, 1997).

In this paper, we empirically investigate another important, albeit understudied, channel

[2]There is also a more direct link between enhanced disclosure and the costs of capital that comes with a reduction in estimation risk (e.g., Lambert, Leuz, and Verrecchia, 2007).

through which disclosure can impact the firm, i.e., improved governance. Leuz and Wysocki (2016) call for more research into this topic because it plays an important role in the economic justification of disclosure and reporting mandates.[3] We view corporate governance as a set of arrangements that help to align managerial decisions with shareholder interests and focus on the role that disclosure plays in reducing agency conflicts between these parties. The key idea is that credible and expanded disclosure can encourage desirable behaviors and discourage undesirable behaviors, which, in turn, lowers the monitoring costs for shareholders, such as institutional investors.

Indeed, several empirical studies suggest that greater transparency can increase the efficiency of managerial decisions. However, most studies in this literature focus on the link with investments and build on cross-sectional variation in voluntary disclosure (e.g., Biddle, Hilary, and Verdi, 2009). Thus, it is important to recognize potential identification challenges. An exception is Greenstone, Oyer, and Vissing-Jorgensen (2006). The authors exploit the passage of the Securities Act Amendments of 1964, which imposed SEC disclosure regulations on larger OTC securities, to analyze changes in firms' operating performance. Their findings suggest that such firms experienced an increase in income and sales growth from 1962 to 1966 relative to size and book-to-market matched NYSE/AMEX firms that were not affected by the disclosure mandate. This is consistent with the notion that disclosure reduces conflicts between the manager and shareholders.

Nevertheless, it is also consistent with potential alternative interpretations, such as a decline in the cost of capital due to better disclosure. More generally, studies assessing the governance role of disclosure face a number of challenges, including difficulties in isolating this channel from the other potential consequences of enhanced disclosure. In other words, existing studies conclude that disclosure reduces agency conflicts on an ex post basis, i.e., in the period after the release of information, which makes it difficult to conclude that better governance drives improvements in the efficiency of firms' investments. In addition, there is a long-standing debate regarding the measurement of investment efficiencies in the literature (Leuz and Wysocki, 2016). Our paper advances this line of inquiry along two important dimensions. First, the disclosure mandate that we exploit in this paper allows us to examine potential governance effects in the

[3] For instance, Leuz and Wysocki (2016, p. 602) note that there is *"much less evidence on how such regulation affects corporate behavior than we have evidence on its capital-market effects [...]"* and further contend that this is of first-order importance because *"disclosure requirements are increasingly used in many areas outside of accounting and financial reporting as a public policy instrument to encourage or discourage certain behaviors."*

period prior to the release of information to the market. Hence, it enables us to control for ex post effects. Second, instead of analyzing investment efficiency, we focus on institutional investors' reactions. Institutional investors are paradigmatic active shareholders and, as such, among the actors most affected by changes in the monitoring dynamics of a firm.[4]

2.2. Theoretical motivation

Our focus is on mandated disclosure regulation. It implies forced disclosure of information beyond what firms would be willing to disclose a voluntary basis. Given this feature, we depart from the model developed in Shleifer and Wolfenzon (2002), who examine the impact of shareholder protection in a market equilibrium model. Their starting point is that expropriation or resource diversion by insiders cannot be entirely precluded by private contracts, as the expected penalties for such behavior are insufficient. Examples of such diversions include expropriation of cash flows for insiders' personal use, empire building or insider trading. Broadly speaking, it relates to any activity that does not maximize shareholder value.

The authors consider an owner-manager (an "entrepreneur" in their terms) who has an investment opportunity and needs financing to realize it. The insider can leverage the investment by obtaining external capital in exchange for a proportion of future cash flows. The insider retains control of the firm but cannot credibly commit to zero diversion before paying out dividends. The insider has incentives to divert some of the firm's resources, thereby reducing the payout to the residual claimants. The insider's payoff depends on whether diversion is detected. If no detection occurs, the insider receives all diverted resources and dividends (her share of the non-diverted resources) upon firm liquidation. If the insider is caught, she must return the diverted resources and, in addition, incur a penalty based on the extent of the diversion. Penalties are assumed to be constant across countries and, hence, do not reflect a differential investor protection element. In this framework, investor protection is considered in terms of the probability of the insider being caught, and this probability varies across countries. The authors assume that this probability is constant for all firms within a country and does not depend on the ownership structure. Investors anticipate diversion by the insider and price shares according to their expectation of the degree of diversion, which depends on the magnitude of the agency problem. Investors invest in the insider's opportunity contingent upon an expected

[4] In fact, Nikolov and Whited (2014) claim that, given the measurement problems associated with other proxies, institutional ownership should be the preferred proxy for firm-level corporate governance.

return that at least equals alternative investments. In the resulting equilibrium, entrepreneurs divert resources, and investors receive the market return for their investment.

Given those settings, we can regard the introduction of mandated disclosure requirements as a feature that unexpectedly increases the probability of the insider being caught. An increase in detection probabilities implies that the insider keeps the diverted amount less often and needs to pay the fine more often. In equilibrium, this lowers the amount of diversion by insiders, which increases expected payoffs to investors. However, evaluating the empirical validity of this theory is complicated by endogenous relationships. It also requires a significant shift in the detection probability to establish economically meaningful consequences. Our use of the AIPA as a natural experiment that exogenously improved a firm's innovation-related information environment has the potential to break that endogenous link. Given evidence (discussed below) that this shock further occurred in settings in which disclosure levels can be considered relatively low, we can test the theory's implication that mandated disclosure causes a reduction in agency concerns (driven by greater detection probabilities), leading to an increase in institutional ownership. This forms our baseline hypothesis.

The key theoretical tension in Shleifer and Wolfenzon (2002) is between the insider and an outside investor. Hence, strictly speaking, their study does not allow for the presence of a large outside shareholder. However, other authors draw on the distinction between managers and large shareholders to analyze the relationship between investor protection and ownership concentration. Himmelberg, Hubbard, and Love (2001) present an inverse relationship between ownership concentration and the quality of legal protection based on the classical tradeoff between risk and incentives. In a model of managerial succession, Burkart, Panunzi, and Shleifer (2003) consider the decision between inside and outside block ownership and demonstrate how inside ownership concentration emerges in regimes with poor legal protection and report separation of ownership and management in regimes with good legal protection. However, the inverse relationship between ownership concentration and the quality of legal rules in this model assumes that investor protection and monitoring are independent for the large shareholder. In contrast, Burkart and Panunzi (2006) argue that investor protection has a direct impact on monitoring incentives and thus affects the mapping from ownership concentration to monitoring. The authors find that when legal protection facilitates monitoring or is independent for the large shareholder, better laws strengthen monitoring incentives, and ownership concentration and investor protection are inversely related. However, when investor protection and monitoring are substitutes, the effect depends on how strongly legal protection reduces monitoring incentives. If this effect is large enough, the block size has to be raised to restore efficient monitoring. Otherwise, it has to be reduced to preserve managerial initiative.

Our main hypothesis is a natural consequence of blending the notion of improved governance due to mandated disclosure with institutional investors' preferences. As in prior research, we define such preferences as the fraction of a firm's shares held by institutional investors. Hence, we need to consider why institutional investors' preferences for those firms are greater than for other individual investors. One difference between institutions and individuals is that institutions have strong fiduciary responsibilities. Del Guercio (1996) shows that institutions have a tendency to invest in stocks that are viewed as prudent investments. Furthermore, Chung and Zhang (2011) document that institutions migrate towards firms with better governance structures. The intuition is that investors are more likely to satisfy "prudent man" rules because such stocks are less prone to expropriation and other self-dealing concerns. A related difference is that institutions have larger stakes in firms than do individuals. This provides the former with more incentives to monitor, particularly when exit is costly. For instance, Bushee and Noe (2000) find that institutional investors have preferences for firms with better disclosure rankings, which reduces monitoring costs. Another difference stems from their preferences for higher liquidity and lower trading costs. This is because institutions trade in larger quantities than individual investors, and hence, the price impact of their trades is larger than that of individual investors. Consistent with this, Gompers and Metrick (2001) find that institutional investors prefer large and more liquid stocks. The results in Chung, Elder, and Kim (2010) suggest that better governance is associated with higher stock market liquidity and lower trading costs.

3. The American Inventors Protection Act of 1999

3.1. Institutional details

We examine the link between mandated disclosure and institutional ownership by leveraging the AIPA as a quasi-natural experiment. In virtually all industrialized countries, patent applications are made public 18 months after the application date. This is true for both successful (granted) and unsuccessful (rejected/abandoned) applications. Until 2000, one exception was the United States. Historically, patent applications filed at the USPTO were been published until the patent was granted. If a patent was never granted, the information was never made public.[5] The AIPA was passed by Congress on November 29, 1999, and intended to harmonize U.S. patent law with international norms. It required that all U.S. patent applications be published by the government 18 months after the application date. This applied to all patent applications filed on or after November 29, 2000.[6] In practice, the earliest wave of new information released under the AIPA started 18 months thereafter, on May 29, 2002. As noted above, this feature allows us to untangle the ex ante impact of mandated disclosure from the ex post impact of public disclosure, two constructs that are often difficult to disentangle in archival studies. Figure 1 summarizes the sequence of events. Policymakers contend that the AIPA is one of the most substantial patent law changes in history (Ergenzinger, 2006). Hence, the impact is likely to be significant.

[Figure 1 here]

The process leading up to the enactment of the AIPA was extremely complex and controversial, including four years of intense debate among legislators, inventors, and other experts.[7] For instance, Representative Rohrabacher (R-Calif) charged that the 18-month publication provision would have the consequence that *"patent lawyers from foreign companies would cull the USPTO files and fax published applications directly to competitors in Thailand, China, Korea, and Japan."* In a similar vein, 26 Nobel Laureates in economics, physics, chemistry, and medicine sent an open letter to the Senate stating that the provision is against the spirit of the U.S. patent system, as it would decrease incentives to innovate. Important opposition was also voiced by independent inventors and their allies. Steven Michael Shore, president of the Alliance for American Innovation, concluded that *"[n]ow there is a legitimate need for patent reform to correct the abuses that have been just recently written into law."* The strong reactions against the 18-month publication provision indicate that voluntary disclosure in this context is rather scarce and that firms regarded the level of disclosure imposed by the AIPA as suboptimal.[8]

[5] U.S. patent applications with a parallel foreign filing were disclosed after 18 months by the foreign patent office. However, as argued by Hegde and Hong (2018) and Saidi and Žaldokas (2020), publication at a foreign patent office is not the same as publication in the U.S. because there were no public records available prior to the AIPA that linked U.S. applications to their foreign counterparts. Furthermore, foreign equivalents may have been published in foreign languages, while U.S.-based entities would only search the USPTO's databases due to resource and time constraints.

[6] An exception from the 18-month disclosure rule is provided for applicants who sign an agreement not to apply for patent protection abroad. In practice, however, the share of applicants that opt out of pre-grant publication is quite small (Graham and Hegde, 2015).

[7] We refer to Ergenzinger (2006) and Saidi and Žaldokas (2020) for the quotes and an extensive description of the legislative process that led to the enactment of the AIPA.

[8] The particular consideration of whether firms (voluntarily) keep their inventions secret or make them public are the proprietary costs of rivals obtaining certain technical knowledge. There is also a large literature on the

Under the AIPA, the disclosure of patent applications is independent of whether an application is eventually granted. Hence, in this new information environment, firm outsiders have information about applications that are either rejected by the patent office or withdrawn by the applicant (i.e., abandoned applications), a unique source of information that was not available before the AIPA. By requiring the disclosure of such unsuccessful inventions, investors and other counterparties should be better able to understand and evaluate the R&D profiles of each firm, particularly when determining how successful the firm is in its patenting efforts. Importantly, the certified and credible disclosure that comes with the AIPA not only provides useful information to investors about one particular firm but also provides benchmarks against which the current firm can be compared, which helps outside investors to better evaluate managerial efficiency or potential agency conflicts and, in doing so, can impact the costs of monitoring.

Indeed, several studies on capital market consequences indicate that the information released under the AIPA is beneficial to investors. For instance, Hegde, Lev, and Zhu (2018) provide examples of Amazon, documenting how firm outsiders use the information available in published patent applications to better understand a firm's innovation activities. A few days after the information release, the public press starts to discuss whether and how the invention could impact the firm's future returns, and analysts incorporate this information into their recommendations. Empirically, the authors also document that abandoned applications contribute to the efficiency of price discovery. Using the AIPA as a shock to firms' information environments, Saidi and Žaldokas (2020) find that firms in industries with a greater acceleration in the revelation of patent documents due to the AIPA are significantly more likely to switch lenders, suggesting that borrowers and lenders make use of the information released under the new regime. Chondrakis, Serrano, and Ziedonis (2019) employ a similar setting to examine the importance of informational frictions in takeover markets. The authors show that the AIPA had a significant impact on the number of acquisitions in disproportionately affected industries; moreover, this has led to a simultaneous decrease in acquirer returns, consistent with the view that lower information asymmetry, uncertainty and search costs stimulate bidding competition for targets.

There is also evidence suggesting that the law is associated with better investment decisions.

impact of property rights on appropriability, suggesting that firms tend to avoid such disclosure. For instance, Cohen, Nelson, and Walsh (2000) find that companies involved in R&D use lead time, secrecy, and other informal appropriation mechanisms more often than they use patents. More recently, Hall, Helmers, Rogers, and Sena (2014) show that, from 1998 to 2006, only approximately 4% of firms in the UK actually patented, and most of them rate lead time and secrecy as better mechanisms to appropriate return from their innovations.

For example, Lück, Balsmeier, Seliger, and Fleming (2020) develop a new measure of blocked future patent applications to show that patent disclosure through the AIPA reduced duplication in performing research. In a similar vein, the working paper by Hegde, Herkenhoff, and Zhu (2018) reports a decrease in the technological similarity between disclosed patents and subsequent patents in the post-AIPA period. The authors also find that post-AIPA patents receive more forward citations than pre-AIPA patents (which may indicate higher patent value), a reduction in patent originality and patent scope (which may indicate less risk taking), and also important, a reduction in application abandonment rates. Although the authors attribute those findings to better information about competing inventions due to greater (actual) disclosure in the post-AIPA period, it is interesting to observe that some of these changes occurred immediately after the AIPA's enactment. As noted above, we focus in this paper on an alternative interpretation that may explain part of this effect: the disciplinary role of mandated patent disclosure.

3.2. Identification strategy

3.2.1. Variation in industry-level average grant lags

The AIPA imposed a uniform disclosure requirement, but prior to the AIPA, there were substantial differences across sectors in the extent to which public records about firms' innovation activities were available to the public (Saidi and Žaldokas, 2020). We use this variation to assess the causal effect of reduced agency costs on institutional investors' preferences. Table A1 in the Appendix reports the average time lag (in years) between patent applications and grants for each sector included in our analysis during the five years prior to the AIPA's enactment (from 1996 to 2000).[9] The variation in patent grant delay across sectors is both substantial and stable over time.[10]

[9] Note that our average delay measure differs from that in Saidi and Žaldokas (2020) in two respects. First, for existing Patent Cooperation Treaty (PCT) applications, we use as the filing date the date when the applicant completed the requirements for entering the national stage under 35 U.S.C. §371. Second, there is evidence that applicants consider the duration of the examination process important and that applicants at times choose to accelerate or delay proceedings for strategic reasons (Harhoff and Wagner, 2009). We address this own-observations problem by using a leave-out measure of average delays. However, nothing hinges on the use of the same delay measure as in Saidi and Žaldokas (2020).

[10] Lacking strong priors, we follow Saidi and Žaldokas (2020) in using two-digit Standard Industrial Classification (SIC) codes in our main empirical analysis. However, because there is substantial heterogeneity within these groups of industries and such heterogeneity is likely to bias the results downwards, we provide conservative estimates. All results when using three-digit SIC codes are available upon request. Furthermore, we follow those authors in capturing actual delays for firms that filed patents in the pre-AIPA period and potential delays for firms that did not file patents but might have filed patents before or would do so in the post-AIPA period. We will show later that our results are concentrated among those firms that filed patents in the pre-AIPA period. We will also provide estimates using delay measures that are either based on the technological fields to which

It seems well established in the patenting literature that evaluation complexity is the most influential factor that explains this variation (Graham and Hegde, 2015). For instance, Popp, Juhl, and Johnson (2003) provide an institutional view of the USPTO, using interviews with patent examiners and patent data, and show that the average grant lags across technology sectors match well with internal productivity guidelines. These productivity guidelines explicitly recognize complexity, and the USPTO allows for more evaluation time in those areas. Following these authors, we provide the example of more complex technology areas such as biotechnology or computers. While the base productivity goal for miscellaneous patents ranges between 12 and 17 hours, the examination time for biotechnology patents is adjusted upwards to 1.75 times that amount (or 21-29 hours); the average grant lag for miscellaneous patents is 25.2 months, while the average grant lag for biotechnology patents is 44.6 months, or 1.77 times that amount. Harhoff and Wagner (2009) examine the determinants of examination duration at the European Patent Office and document that the patent characteristics frequently used in the literature to capture complexity (i.e., the number of claims, the number of patent and non-patent references, and the number of patent classes) are all associated with longer approval delays. Finally, there is also some literature that exploits grant lags as a source of variation in patenting outcomes. For instance, Gans, Hsu, and Stern (2008) examine the impact of uncertainty, information asymmetries and search costs on the potential failure to achieve productive licensing agreements.

In sum, we operate under the assumption that firms in industries with longer average grant lags prior to the AIPA are more difficult to evaluate and that the reduction in monitoring costs due to mandated disclosure that comes with the AIPA is magnified for firms in those industries. Indeed, and in combination, the existing evidence discussed in Section 3.1 supports the view that patent disclosure due to the AIPA reduces evaluation costs and information asymmetries between firm insiders and outsiders, particularly for those industries with longer publication lags during the pre-AIPA period.

3.2.2. Correlation with other industry-level determinants of institutional ownership

In addition, we provide suggestive evidence that our delay measure does not capture other industry-level characteristics that might be associated with institutional investors' preferences through other channels. To do so, we follow Saidi and Žaldokas (2020) and estimate cross-sectional regressions at the (two-digit SIC) industry level. The dependent variable is the av-

firms' patents are assigned or specific to the examiner responsible for reviewing firms' applications.

erage difference in years between filing and grant dates across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. We restrict the sample to those industries included in our main analysis. All independent variables are measured either as total or average values between 1996 and 2000.

Column 1 of Table 1 reports the correlation between our delay measure and the total number of patents filed in a given two-digit SIC industry. A potential concern is that patenting-intensive industries have higher growth opportunities and longer delays, as average patent pendency is likely to increase with patent examiner workload. Moreover, this relationship could also drive institutional investors' decisions (Ferreira and Matos, 2008). However, we do not find a meaningful correlation, suggesting that differences in patenting intensities do not capture industry-level variation in grant lags. Column 2 considers the average patent quality (as measured by forward citations) in a given two-digit SIC industry. Again, we find no correlation with our delay measure. In addition, we examine the correlation with the degree of product market competition using the Herfindahl index based on market shares. Arguably, the degree of product market competition could affect both patenting and whether applicants choose to accelerate or delay the application process. However, in column 3, we find no relationship between our delay measure and product market competition.

Next, in column 4, we use the average total factor productivity in a given two-digit SIC industry based on the data from Imrohoroglu and Tuzel (2014). There is no statistically significant correlation between our delay measure and productivity, suggesting that our measure does not capture such confounding industry characteristics. Finally, we investigate the relationship between stock returns and our treatment indicator. One might be concerned that the effect we capture is related to the burst of the dot-com bubble and the ensuing recession, as it coincides with the implementation of the AIPA. To assess this, we correlate our delay measure with the equally weighted average of stock returns for firm each in a given two-digit SIC industry between 1996 and 2000. We find no statistically or economically significant relation, as shown in column 5, suggesting that the dot-com bubble and subsequent recession are not driving our results. We will return to this and other potential confounding events in the robustness test.

[Table 1 here]

4. Data

4.1. Sample selection

Our baseline sample includes firm-quarter observations in the period from the fourth quarter of 1999 through the fourth quarter of 2001. We exclude the fourth quarter of 2000 to avoid complications related to the implementation of AIPA. In practice, the AIPA entailed the release new information beginning in May 2002, so, again, we focus on the period leading up to the release of the information. We later explore the sensitivity of our results to this set of choices by contrasting the estimates when including the fourth quarter of 2000 (1999 Q3 – 2000 Q3 for the pre-AIPA period and 2000 Q4 – 2001 Q4 for the post-AIPA period) and longer sample frames (8, 12 or 16 quarters) to form pre-post contrasts.

We obtain accounting data from the Compustat databases, stock price data from the Center for Research in Security Prices (CRSP), analyst coverage data from the Institutional Brokers Estimates System (I/B/E/S), corporate governance information from the IRRC Governance database, managerial compensation and tenure data from the Compustat Executive Compensation file, probability of informed trading data from Stephen Brown's website (http://scholar.rhsmith.umd.edu/sbrown/pin-data), and bid-ask spreads from Farshid Abdi's website (http://www.farshidabdi.net/data/). Patent data are obtained from the 2006 version of the National Bureau of Economic Research (NBER) patent database.[11] For institutional ownership, we use Thomson's CDA/Spectrum 13F Holdings database and institutional investor classification data from Brian Bushee's website (http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html).[12]

4.2. Variable construction

When constructing the sample of firm-quarter observations, we restrict attention to common stocks (share codes 10 and 11) in the CRSP monthly file; this includes all stocks listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and National Association of Security Dealers Automated Quotations (NASDAQ) National Market System. We eliminate financial and utility firms (with SIC codes 4900 – 4999 and 6000 – 6999) and only retain firms

[11] Available at (last accessed November 4, 2019): https://sites.google.com/site/patentdataproject/Home.

[12] Any financial institution exercising discretionary management of investment portfolios over $100 million in qualified securities is required to report its aggregate holdings quarterly to the SEC using Form 13F; all common stock holdings of 10,000 or more shares or having a value of $200,000 or more must be reported. Throughout the paper, we thus define an institutional owner as an institution that files a 13F.

that are headquartered in the U.S. For the baseline sample, we then merge these data with the 13F filings and Compustat and restrict our sample to firms with non-missing information on the treatment variable and controls. Unless otherwise noted, all variables are measured at the same quarter-end as the 13F filing. For most of our tests, our sample period is from Q4 1999 to Q4 2001 and contains 22,375 firm-quarter observations with 3,558 firms in an unbalanced panel. Table A2 in the Appendix defines in detail the variables used in the baseline for this study and lists their sources. Table 2 presents the summary statistics.

4.2.1. Institutional ownership variables

The main ownership variable used in this paper is the institutional ownership ratio, defined as the fraction of a firm's stock owned by institutional investors. We sum the holdings of all reporting institutions for a specific stock in a given quarter and divide it by the split-adjusted shares outstanding for the firm. Following Gompers and Metrick (2001), we set the institutional ownership variables to zero if a stock is not held by any institution in Thomson's CDA/Spectrum 13F Holdings database. We also consider several additional institutional ownership metrics. First, for each firm, we calculate the variables institutional ownership concentration, institutional ownership breadth, and blockholder ownership. Institutional ownership concentration is the Herfindahl index based on the fractions of institutional holdings by all institutions in 13F, as in Ferreira, Ferreira, and Raposo (2011). Institutional ownership breadth is the fraction of market institutions holding long positions in a stock in a given quarter (Chen, Hong, and Stein, 2002). Due to the high skewness of institutional breadth, we use the logistic transformation of this variable for the calculations. Blockholder ownership is the fraction of shares controlled by blockholders, which are defined as holdings by institutions with at least 5% of the outstanding shares. Second, following Chen, Harford, and Li (2007), we use the refined (or "reliable" to use Bushee's term) CDA/Spectrum classification to group institutional ownership according to the institution's potential business ties with the invested firm. We classify the fraction of shares held by CDA type 1 (banks), type 2 (insurance companies) and type 5 (private pension funds, university and foundation endowments, miscellaneous) institutions as ownership by gray investors and type 3 (investment companies), type 4 (independent investment advisors) and type 5 (public pension funds) institutions as ownership by independent investors.

4.2.2. *Control variables in the baseline specification*

Most variables used by Gompers and Metrick (2001) in their institutional ownership regressions are included in the baseline specification in our study. The variables include a firm's market capitalization (*Size*); share turnover, measured in the month prior to the beginning of the quarter (*Turnover*); stock returns in the filing quarter ($Momentum_{-3,0}$) and in the nine months preceding that quarter ($Momentum_{-12,-3}$); the standard deviation of monthly stock returns over the last two years (*Volatility*); the number of quarters passed since the firm first appears in the CRSP database (*Age*); cash dividends for the fiscal year that ended before the most recent June 30, divided by firm size at fiscal-year end (*Yield*); and a dummy variable indicating whether the firm belongs to the Standard & Poor's 500 index (*S&P 500*). Market-to-book (*M/B*) is the ratio of size for the fiscal-year end before the most recent June 30, divided by the book value of equity for that fiscal year. According to Ferreira and Matos (2008), there is also a common preference among institutional investors to invest in firms with investment opportunities and profitability. Thus, we further include the return-on-asset ratio (*ROA*); investments in intangible assets, measured by R&D expenditures, scaled by total assets (*R&D*) for the fiscal year ended before the most recent June 30; and the two-year geometric average of the quarterly growth rate in net sales (*Sales Growth*). Since most institutional ownership variables are ratios, we use the natural logarithm for all the above continuous variables in our regressions, except for the two momentum measures.

[Table 2 here]

5. Econometric modeling strategy

We are interested in whether the AIPA mandate affected institutional inventors' preferences. Figure 2 depicts the effect of the AIPA on the institutional ownership ratio. Based on the pre-AIPA average patenting delay, we sort sample firms into quartiles and retain only the top quartile, representing firms with the longest lags between application filing and patent grants before the AIPA, and the bottom quartile, representing firms with the shortest lags. On the y-axis, the graph shows the ratio of outstanding shares owned by institutional investors in a given quarter; the x-axis shows the time relative to the quarter of the enactment of the AIPA (ranging from four quarters prior to the AIPA to four quarters afterwards). The bars in the graph correspond to the 95% confidence intervals of the coefficient estimates. We see that the confidence intervals include zero before the AIPA and that institutional ownership clearly increases thereafter.[13]

[Figure 2 here]

The AIPA became effective for all firms at the same time, but the mandated disclosure effect of the AIPA on institutional investors' preferences should differ across sectors, as discussed in Section 3.2. Thus, we can examine the before-after effect of a change in the mandated disclosure for firms operating in industries in which information costs are higher vis-à-vis the before and after effect in industries in which such costs are lower. This is a DiD test design in a setting where the treatment is continuous. We implement this test through the following panel regression:

$$Y_{i,t} = \alpha + \beta \; Treatment_i \times Post_t + \gamma \; Z_{i,t} + \delta_t + \lambda_i + \varepsilon_{i,t} \tag{1}$$

where i and t index the firm and time, respectively. The dependent variable, $Y_{i,t}$, corresponds to the different institutional ownership ratios described in Section 4.2.1. Our main variable for the baseline specification is the fraction of outstanding shares held by all institutional investors (IOR) in a given quarter t. $Treatment_i$ is based on the industry level (two-digit SIC codes) and measures the average difference (in years) between the filing date and the grant date across all patents granted to firms in the Computsat-USPTO match during the period between 1996 and 2000. As explained above, a potential concern is that grant lags are biased when each firm's own observations are included in the estimation of grant lags on institutional investors. As an example, a firm may delay its own examination process to increase uncertainty for rivals (Harhoff and Wagner, 2009). We address this issue by omitting a firm's own observations when calculating industry averages, although our results are almost identical when including them. $Post_t$ is an indicator variable equal to one for the post-AIPA period. $Z_{i,t}$ is the vector of firm-level, time-varying determinants of institutional ownership described in Section 4.2.2. δ_t

[13] More formally, the graph plots the point estimates and 95% confidence intervals (based on standard errors that are clustered by firm) of the estimates on β_τ from the following regression:

$$Y_{i,t} = \alpha + \sum_{\tau=-4}^{4} \beta_\tau \; Treated_i \times L_{t-\tau} + \delta_t + \lambda_i + \varepsilon_{i,t}$$

where $Y_{i,t}$ is the institutional ownership ratio in a given quarter t. δ_t and λ_i are dummies that correspond to year-quarter and firm fixed effects, respectively. $Treated_i \times L_{t-\tau}$ is the interaction term between a variable indicating the year relative to the AIPA's effective mandate (Q4 2000) and a variable indicating whether firm i belongs to the top or the bottom quartile of the distribution of the pre-AIPA difference in the time lag between patent applications and grant dates.

and λ_i are dummies that correspond to year-quarter and firm fixed effects, respectively. The main coefficient of interest is β, which tests for changes in institutional ownership for firms in industries with differential patent grant lags following the AIPA's implementation. Under the assumption that changes in institutional ownership would be comparable for firms in sectors with higher and lower average patent grant lags had the AIPA not occurred, the DiD model allows us to identify the causal effect of mandated disclosure. We cluster standard errors at the firm level to account for the fact that among patenting firms, the relevant level of variation is the firm level. However, as we show below, our results are also robust to clustering at the industry level.

6. Empirical results

6.1. Baseline results

Table 3 contains the basic results from estimating Eq. (1). Columns 1 and 2 report ordinary least squares (OLS) estimates where the dependent variable is the logistic transformation of the fraction of shares held by institutional investors (so we drop observations with an institutional ownership ratio that is either zero or one). Columns 3 and 4 report Tobit regressions, and columns 5-7 return to OLS regressions but with the dependent variable replaced by the plain institutional ownership variable instead of its transformation, the common approach used in the related literature (Gompers and Metrick, 2001; Ferreira and Matos, 2008; Chung and Zhang, 2011). Across the relevant columns of Table 3, the DiD coefficient is positive and significant at the 1% level. Consistent with the relationship visualized in Figure 2, this suggests that firms in industries with longer pendency times exhibit an increase in institutional ownership post AIPA. This increase is also sizable. For instance, a coefficient of 0.037 implies that a shock to monitoring costs due to mandated patent application disclosure is associated with a 6 percent increase in institutional ownership in the four-quarter period following the AIPA relative to the four-quarter period preceding the AIPA for firms in complex industries compared to firms in miscellaneous industries (i.e., 0.037×1.7).[14]

Column 1 of Table 3 reports OLS regressions of the logistic transformation of institutional ownership on the delay measure, the full set of control variables, and time dummies. The coef-

[14] As noted above, the base productivity goal at the USPTO is 17 hours, while the time allocated for more complex sectors such as biotechnology and computers is 29 and 32 hours, respectively (Popp, Juhl, and Johnson, 2003). Thus, 1.7 is a reasonable change to consider.

ficient on the delay measure, $Treatment_i$, is negative (but insignificant), which indicates that, on average, firms in industries with longer patenting delays tend to have lower stock ownership by institutional investors. Column 2 includes the interaction term between $Treatment_i$ and $Post_t$ so that the equation captures the DiD effect. The coefficient on this term is positive and significant, suggesting that mandated patent disclosure is associated with a boost in institutional ownership. Columns 3 and 4 repeat the specifications of the first two columns but use Tobit models to account for potential censoring issues. Since zeros and ones can now be used, the number of observations increases. The coefficient on the DiD estimator remains significant, with a marginal effect of 0.043 (standard error of 0.015). Columns 5 and 6 repeat the Tobit specifications but again use OLS models. We obtain a DiD coefficient of 0.044 (standard error of 0.015), which is almost identical to that obtained in the Tobit specification. This indicates that censoring does not pose an important challenge to this estimation approach. The last column of Table 3 presents the baseline OLS model that we use throughout the paper; it includes firm fixed effects instead of the continuous treatment variable to control for time-invariant characteristics omitted from the regressions that may bias the DiD estimate. These reduce the marginal effect of the DiD estimate from 0.044 to 0.037.

Some of the control variables in the baseline regression are significant. The coefficients on firm size and share turnover are positive and significant at the 1% level. This suggests that institutional investors have a strong preference for the stocks of larger firms and stocks that are more liquid, which is consistent with Gompers and Metrick (2001). The negative and significant (at the 1% level) coefficients on the momentum measures, on the other hand, indicate that large institutions tend to avoid stocks with higher historical returns. This also matches the earlier finding by Gompers and Metrick (2001). Institutional investors are averse to stocks with higher return volatility, which confirms the results in Chung and Zhang (2011). The market-to-book ratio has a positive and significant coefficient (at the 1% level), which implies that institutions share a preference for value stocks, as documented in Ferreira and Matos (2008). Our results further reveal that institutions are prone to chase the stocks of more established (older) firms, as the coefficient on firm age is positive and significant at the 1% level. Taken together, the results on the control variables are in line with prior studies in that institutions seem to prefer stocks with safety net characteristics.

The validity of the DiD estimate critically depends on the assumption that in the absence of the AIPA changes, institutional ownership would be comparable for firms in industries with longer or shorter patenting delays. While it remains impossible to formally test this, we present two tests to show that we, at least, do not violate the assumption. First, in Figure 2, we observe a post-AIPA trend in institutional ownership for firms in the treatment group vis-à-vis those in the control group (firms in the top and the bottom quartiles of the distribution of the pre-AIPA delay measure). Because identification in DiD settings comes from a before-after comparison in levels between the treatment and control firms, it is a necessary condition that the counterfactual trend behavior of treatment and control firms is the same. Figure 2 suggests that this requirement is satisfied in our setting. Second, we check for the existence of diverging pre-trends by conducting a falsification test in which we replicate the exact same experiment as in the baseline model but shift the AIPA event to the fourth quarter of 1997, 1998, and 1999. The results are shown in columns 1 through 3 of Table 4. We observe that the treatment effect is not statistically significant for these placebo periods. Consistent with the observation in Figure 2, this suggests that the treatment effect in our baseline specification does not arise mechanically.

This falsification test can also help us rule out alternative explanations for the results reported in Table 3. For example, there could be an unobservable that affects the treatment and control groups differently and is correlated with institutional ownership, which is not captured by the control variables or firm fixed effects. However, if this were the case, we should also observe a significant correlation between patent pendency lags and institutional ownership in other periods, not just in the period when the AIPA became effective.

[Table 3 here]

6.2. Confounding events

As noted above, one concern regarding the use of the AIPA is that it overlaps with the burst of the dot-com bubble and the ensuing recession. Hence, it is possible that the dot-com bubble and the subsequent recession differently affect the treatment and control firms and correlate with institutional ownership. We address this in two ways.

First, we run a falsification test in which we examine whether capital expenditures (Compustat Quarterly Item #90); property, plant, and equipment (#42); acquisitions expenditure (#94); the sale of property, plant, and equipment (#83); and the sale of other investments (#85) changed significantly for treatment firms surrounding the AIPA. All five variables are scaled by total assets (#44) and are winsorized at the top and bottom 2% of each variable's distribution.

If the observed relation between enhanced disclosure requirements and institutional ownership for the treatment firms (compared to the control firms) is driven by the dot-com bubble and the recession, we should also observe a change in these variables. We report the results in columns 4 through 8 of Table 4. However, the DiD estimator is not statistically significant in terms of changes in all these variables surrounding the AIPA.[15]

Second, we exclude a number of high-tech sectors from the sample that, following Ljungqvist and Wilhelm (2003), were particularly affected by the burst of the bubble and subsequent recession.[16] We report the results in column 9 of Table 4. The DiD coefficient remains positive and significant (at the 5% level), although the magnitude of this effect becomes smaller than the baseline estimate (0.026 versus 0.037). In sum, our findings do not appear to be explained away by the dot-com bubble or the recession that occurred thereafter.

[Table 4 here]

On August 10, 2000, the U.S. Securities and Exchange Commission (SEC) approved Reg. FD, which became effective on October 23, 2000. Reg. FD prevents selective disclosure by firms to analysts and other investment professionals, a regulation intended to equalize the quantity and quality of information available to ordinary investors. For example, it requires advance warning of earnings communicated to a security analyst to be immediately released to the public via a press release, open conference call, or other public announcement. Although empirical evidence remains mixed (see Beyer, Cohen, Lys, and Walther, 2010, for a discussion), some papers conclude that the implementation of Reg. FD improved firms' overall information environment. Therefore, one might be concerned that the effect we capture is related to Reg. FD, as it was implemented in the same quarter as the AIPA.

We must also acknowledge another structural event that spans our sample period, which is when the NYSE, AMEX, and the NASDAQ implemented stock price decimalization. Over the period from August 28, 2000, to January 29, 2001, the NYSE and AMEX began to convert all stocks from fractional prices (in multiples of 16 price points) to decimal prices, while the NASDAQ switched to decimals over the period from March 12, 2001, to April 9, 2001. Prior research finds a reduction in trading costs and an increase in liquidity following decimalization,

[15] Note that these results remain unchanged if we divide all five variables by net sales instead of assets.

[16] Those are the following (four-digit) SIC codes: 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3674 (electronics), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 4899 (communication services), and 7370, 7371, 7372, 7373, 7374, 7375, 7378, and 7379 (software).

particularly among stocks that are actively traded (Bessembinder, 2003). This can have an important impact on firm behavior. For example, Fang, Tian, and Tice (2014) report a reduction in innovation output (as measured by patents and citations per patent) for those firms that experience the largest increase in liquidity due to decimalization. The suggested mechanism for this is the increased exposure to hostile takeovers and the presence of more institutional investors that do not actively gather information or monitor.

Although the DiD methodology is quite powerful at addressing resulting concerns, as it requires a confounding event to have a similar rank of exposure across firms, we account for the potential bias in three ways. First, our basic approach is to condition on many observables that correlate with the exposure to those events, such as firm size, S&P 500 membership, stock liquidity or firm fixed effects. Second, we explicitly explore this issue by identifying firms that were most affected by Reg. FD and decimalization. If the results are driven by those regulatory changes, the positive impact of the AIPA on institutional ownership should be concentrated among the subset of firms that are more affected by them. To test the extent to which Reg. FD affects our results, we estimate differences that distinguish firms that are followed by analysts in the four quarters prior to the AIPA's implementation from firms without analyst coverage. For decimalization, we examine whether the effect is concentrated among firms that were more actively traded prior to the AIPA. Because we focus on firm characteristics prior to the AIPA, the number of observations available for estimation is reduced.

Columns 1-10 of Table 5 present the results using a series of split sample regressions. Columns 1 and 2 show that the DiD estimate is similar among firms with analyst coverage compared to firms without such coverage. Though the smaller sample sizes reduce precision, both estimates remain significant and very close to that obtained in our baseline. A potential concern is whether the impact of Reg. FD depends on the number of analysts following, so instead, we consider firms with high (low) coverage to represent those with analyst coverage above (below) the sample median prior to the AIPA. Columns 3 and 4 show that the DiD estimate is larger and more significant when fewer analysts are following. Columns 5-10 report results when we separate our sample into firms with low and high stock trading activity to assess the impact of decimalization. We define firms as more (less) affected by decimalization as those with high (low) share turnover, low (high) bid-ask spread or high (low) PIN. In all six columns to explain decimalization, we observe that the treatment coefficients are smaller and less significant for those firms with less stock trading activity prior to the AIPA. Hence, the positive impact of the AIPA on institutional ownership does not appear to be concentrated among firms more exposed to decimalization. Interestingly, these results also have some implications for our suggested mechanism. In particular, under the hypothesis that mandated disclosure matters for governance and thus institutional investors' decisions, one would anticipate that the relative increase in governance quality due to mandated disclosure should matter less for firms with ex ante lower information asymmetries and/or high external monitoring. Therefore, the finding that the impact of the AIPA tends to be weaker among firms with more analysts following, higher share turnover, smaller spreads, and higher PIN values seems to be consistent with our story.

An alternative approach to addressing confounding events is to leverage another shock to innovation disclosure that occurred at a different moment in time. We follow Saidi and Žaldokas (2020) and exploit the announcement by the Clinton administration to make available all patent and trademark information free to the public on the USPTO's website in 1998 (hereinafter, the 1998 shock).[17] According to the June 25, 1998, USPTO press release,[18] *"This electronic database is one of the largest Web offerings by a government agency. By providing better access to information on intellectual property, innovation, and investment, we are achieving our goal of helping electronic commerce become a strong contributor to growth and jobs. [...] It will bring greater efficiency to issuing quality patents, registering quality trademarks and help strengthen protection of intellectual property that is of paramount importance to inventors, businesses and the public."*

For our main analysis, we build a sample spanning the four quarters before and after the event, i.e., from Q2 1997 to Q2 1999. This leaves us with 23,155 firm-quarter observations on 3,244 firms. The intuition behind this analysis remains the same: firms in industries with relatively high patenting delays should be more affected by instances of patent disclosure. In column 8 of Table 5, we report the DiD estimator from estimating Eq. (1) but rely instead on the shock to innovation disclosure generated by the 1998 event. The DiD estimator is positive and significant at the 10% level. The magnitude of the DiD estimator suggests that, on average, the shock to innovation disclosure in 1998 results in an increase in institutional ownership of

[17] Another important disclosure event took place in November 1995 when the PTO provided Internet access to patent bibliographic data and abstracts. However, this overlaps with the Uruguay Rounds Agreements Act, which became effective in June 1995 and changed the patent term in the U.S. from 17 years of patent life from the date the patent was issued to a 20-year patent life from the date of the first filing of the patent application.

[18] The press release is available at https://www.uspto.gov/about-us/news-updates/uspto-make-comprehensive-patent-and-trademark-data-available-free-internet.

approximately 5 percent in the four-quarter period following the shock relative to the four-quarter period preceding the shock for the disproportionately affected firms compared to the less affected firms.

[Table 5 here]

In sum, we find that firms more affected by the 1998 disclosure event exhibit a significant increase in institutional ownership in the following quarters. Thus, our results are robust across two events that took place on different dates. This should further reduce concerns regarding alternative explanations. However, one advantage of using the AIPA for our purpose is that it provides us with a much clearer identification of the information available to firm outsiders. The 1998 shock followed a second wave of digital patent data with the posting of all patent bibliographic data and abstracts on the USPTO's website in 1995. Moreover, it was possible for investors to access the full range of technical information available on patent documents via several patent libraries that introduced automated search in 1982. Hence, an institution that incurs costs could readily access this information prior to the 1998 event. In contrast, the AIPA, with the release of application-related information, represents a shock to the mandated disclosure of information that was not possible to retrieve elsewhere. Given this difference, it is not surprising that the effect of the 1998 event is, on average, statistically and economically weaker than that of the AIPA.

6.3. Miscellaneous robustness tests

We perform many other experiments to check the robustness of our main findings. We rerun our baseline specification on a balanced panel, in which we require firms to be in the sample over the entire pre- and post-AIPA period, to check for attrition bias. This yields results similar to the unbalanced panel. For example, repeating the specification of Table 3, column 7, leads to a DiD coefficient (standard error) of 0.033 (0.012) on this subsample of 17,014 observations, as we show in the Appendix, Table A3. Clustering the standard errors at the two-digit SIC industry level instead at the firm level also makes little difference (see Appendix, Table A4). We also address the concern that the main DiD estimate could be driven by the inclusion of specific control variables. To that end, we drop all controls from the right-hand side of Eq. (1) and show that this leads to a marginal effect on the DiD estimate (a coefficient of 0.037 with a standard error of 0.014), which is identical to our baseline estimate, as shown in column 1 of

Table A5 in the Appendix.

Next, we examine whether our main DiD estimate remains robust to alternative treatment definitions and report the results in columns 2-6 of Table A5 in the Appendix. We observe that our results are robust to capturing treatment effects with a binary variable. Based on the distribution of average grant lags, we sort sample firms into quartiles and retain only the top quartile representing the treatment group and bottom quartile representing the control group. The DiD estimate (reported in column 2) is 0.018 and significant at the 1% level. In column 3, we return to the continuous treatment definition but use the median, rather than the mean, delay from filing to grant, and continue to observe a positive and significant DiD estimate (a coefficient of 0.028 with a standard error of 0.010). We address the problem that the AIPA was signed into law in November 1999 but implemented in November 2000. Although firms filed patents under the pre-AIPA regime, it was clear that the AIPA would be implemented. In column 4, we obtain a DiD estimate of 0.031 (standard error = 0.011) when using a continuous treatment that is based on mean delays from 1995 to 1999, instead of 1996 to 2000. Finally, in the last two columns of Table A5, we restrict the sample to firms with at least one patent grant between 1996 and 2000 and use the distribution of average grant lags across patent classes (in column 5) and patent examiners (in column 6), rather than industries, as a treatment definition.[19] The treatment effects remain significant at the 1% level, but we obtain larger marginal effects (0.042 in column 5 and 0.041 in column 6) than in our baseline.

Finally, we assess whether our baseline DiD estimate is robust to using alternative pre- and post-period contrasts. Our baseline specification uses the four quarters before and after the AIPA's implementation. In Table A6 in the Appendix, we explore the sensitivity of our findings to this choice. In column 1, we move the posttreatment window closer to the point of implementation by 1 quarter (that is, immediately thereafter). This produces a robust coefficient of 0.030 on the DiD estimate (standard error = 0.010). In columns 2-4, we expand the posttreatment window and include 8, 12, and 16 quarters following the AIPA, respectively. As the first regular pre-grant disclosure occurred in the second quarter of 2002, those estimates thus capture the combined ex ante and ex post impact of mandated patent disclosure on institutional ownership. For reference, we hold the pretreatment window constant in those regressions, although we ob-

[19]To construct the examiner-specific delay measure, we retrieve information on patent examiners and their art units from the Patent Examination Research Dataset (Public PAIR, 2017 release). Following the literature on firm-level examiner leniency, we use the difference between the grant lag of the examiner assigned to review the patent and the average grant lag of her corresponding art unit. We then average this difference across all patents granted to the firm.

tain very similar results if we adjust it to each posttreatment window. We find that the DiD estimate gradually increases with longer posttreatment periods. For instance, when considering the 16-month period following the AIPA, the estimated institutional ownership increase (0.058) is approximately two-thirds larger than the baseline values and significant at the 1% level. Overall, and possibly less surprising, this suggests that there is an important informational effect due to the AIPA that attracts institutional investors via greater firm transparency.

6.4. Alternative institutional ownership variables

In this section, we examine alternative dependent variables to further assess the robustness (and interpretation) of our results. First, we perform an alternative test of our baseline hypothesis by examining the relationship between mandated disclosure and ownership concentration as well as the proportion of institutions that hold shares. Second, we consider institutional investor type according to their preferences for monitoring. We characterize institutions as independent institutions (mutual fund managers and investment advisers) and gray institutions (bank trusts, insurance companies, and other institutions). Chen, Harford, and Li (2007) establish that independent institutions are motivated by active monitoring rather than trading. Gray institutions will not monitor, as this may harm their business relationships with the firm. Therefore, to the extent that mandated disclosure reduces monitoring costs in the period leading up to the arrival of new information, we anticipate that the increase in institutional ownership we observe is concentrated among independent institutions. Third, Edmans (2009) argues that blockholders are important for monitoring since their sizable stakes give them incentives to incur the cost of monitoring managers. Blockholders also have more resources to engage in and utilize specialized information gathering. If mandated disclosure decreases the costs of monitoring, we should observe a reduction in the size of the stake held by blockholders.

The results from estimating Eq. (1) on this set of dependent variables are presented in Table 6. In the ownership concentration (proxied by the Herfindahl measure) regression in column 1, the DiD coefficient is negative and significant at the 1% level. In other words, mandated disclosure leads to more dispersed ownership for firms more affected by the AIPA. Column 2 shows that this reduction in ownership concentration does not come from a lower preference by institutional investors, as the DiD coefficient in the ownership breadth regression (the number of investors that own a stake in a particular firm over the total number of institutions in the sample for that quarter) is positive and significant. Hence, the effect we observe is due to a reduction in the average stake held by institutions, which is consistent with a decreasing demand for costly monitoring. We next differentiate between the fraction of ownership held by gray (column 3) and independent (column 4) investors. Consistent with the theoretical predictions, we observe that the effect of mandated disclosure is small and statistically insignificant for gray investors, whereas it is much larger and statistically significant for independent investors.[20]

Columns 5 and 6 focus on the impact of the AIPA on blockholder ownership (defined as the percentage of stock held by institutions owning 5% or more of a firm's shares). Column 5 shows that the impact of the AIPA on blockholders is negative, although the coefficient is small and not significant. However, this is not surprising, as those investors face substantial concerns regarding the price impact of their trades in the absence of sufficient market liquidity. To account for this, we repeat the same specification but focus on the subsample of stocks with high liquidity in the pre-AIPA period (i.e., the top quartile of the sample in share turnover). As column 6 shows, the DiD becomes significant at 10% with a much larger (-0.008 versus -0.074) marginal effect. Taken together, these findings indicate that large block ownership decreases with mandated disclosure, and this reduction is concentrated among most liquid firms for which the costs of exit are lower.

[Table 6 here]

6.5. *Other supporting evidence and internal monitoring intensities*

We continue to explore heterogeneity in treatment intensities by examining certain subsamples of firms. First, our empirical approach assumes that all firms are treated to some extent but differ in their innovation-related evaluation costs. This is because prior to the AIPA, the market had no certified information beyond patent grants, and it is plausible that some firms applied for patents but never met the USPTO patentability requirements. However, and from a theoretical perspective, it is natural to expect that the positive impact of mandated innovation disclosure on institutional ownership is more concentrated among industries in which patents are more important and among firms that are expected to file patents. Indeed, the first two columns of Table 7 reveal that the effect is smaller and statistically insignificant among firms in non-manufacturing industries (other than SIC codes 2000-3999), whereas it is larger and signif-

[20] An interesting observation here is that this evidence also suggests that our results are not simply a byproduct of stock market decimalization. In particular, Fang, Tian, and Tice (2014) attribute their finding that an increase in liquidity due to decimalization decreases innovation in part to an increase in institutional investors that lack monitoring incentives. This is the opposite of what we observe.

icant among firms in manufacturing industries (SIC codes 2000-3999). In the last two columns of Table 7, we also find that the treatment effect is significantly stronger for firms that patented in the pre-AIPA period.

[Table 7 here]

Second, we explore whether the relationship between mandated disclosure and institutional ownership varies across internal monitoring mechanisms. Our theory is more plausible for firms in which managers are more able to divert corporate resources for private gain. Although such diversions are unobservable, we can test whether institutional investors' decisions are more influenced by mandated disclosure for firms in which there is more scope for diversion by the manager. We anticipate that the relative importance of improved governance due to mandated disclosure to institutional investors is more important for firms in which effective internal monitoring is more difficult. Resource diversion by insiders is likely to be particularly severe when it is more difficult for the board to gather firm-specific information, when the board is less independent, and when the manager has more power to weaken the monitoring ability of the board (Ryan and Wiggins, 2004; Adams and Ferreira, 2007; Coles, Daniel, and Naveen, 2008). Differences in how much managerial wealth is tied to the value of a firm's assets is another test. Although high managerial ownership may help to reduce other agency conflicts by inducing a manager to work hard, it exacerbates the agency problem we focus on by increasing managers' incentives to extract private benefits (Goldman and Slezak, 2006).

To analyze the importance of internal monitoring mechanisms and managerial ownership for how institutional investors respond to mandated disclosure, we use several empirical proxies that are used in the governance literature and classify firms based on the sample median in the year prior to the AIPA into firms with weak and strong monitoring ability of the board as well as with low and high values of managerial ownership. The first proxy is firm-specific knowledge. The idea is that when managers possess more firm-specific information than the board, the costs associated with the acquisition of firm-specific knowledge make monitoring more difficult. We follow Coles, Daniel, and Naveen (2008) and define firm-specific knowledge using the ratio of R&D to total assets. The second proxy is board independence, measured by the fraction of independent directors. Ferreira, Ferreira, and Raposo (2011) interpret it as the monitoring intensity of the board. Our third proxy is CEO power. We follow common practice and measure it using CEO tenure. Hermalin and Weisbach (1988) suggest that CEO power increases over time, diminishing the power and independence of the board, causing it to monitor managerial decisions less. Ryan and Wiggins (2004) find that board monitoring decreases with CEO tenure. Finally, we measure managerial ownership using the reported shares held by the CEO as a fraction of the firm's total shares outstanding.

The estimates are presented in Table 8. We find that the increase in institutional ownership due to mandated disclosure is concentrated among firms in which firm-specific knowledge is more important and firms with less independent boards, higher managerial power, and higher managerial ownership. We interpret these results as evidence that the relationship between institutional ownership and mandated disclosure is stronger among firms with weaker internal monitoring. These governance and ownership results, combined with the result that the effect is less driven by firms with strong external monitoring, are consistent with the hypothesis that the mandated disclosure reduces ex ante expectations about resource diversion, which, in turn, drives the increase in institutional ownership.[21]

[Table 8 here]

6.6. *Information content of stock prices*

A natural last step is to examine the link between mandated disclosure and the informativeness of stock prices. If mandated disclosure increases institutional ownership by reducing the extent to which managers can extract private rents, it can also lead to more efficient stock prices. Morck, Yeung, and Yu (2000) show that in countries with stronger shareholder protection, the synchronicity of stock returns (measured by a market model R^2) is significantly lower. The authors argue that investor protection increases the benefits from arbitrage and investors' willingness to generate and trade on private information. Jin and Myers (2006) consider the link between the level of opacity of firms and return synchronicity. The authors predict that the lack of full transparency concerning firm performance helps the manager extract part of the firm's cash flows as private rents, which dampens part of the variation in firm-specific performance. As a result, market-wide information explains a smaller proportion of the overall return variation, resulting in lower return synchronicity. Their results from 40 stock markets and several measures of opaqueness confirm this prediction.

[21] One remaining potential concern with our interpretation is that institutional investors anticipate spillover benefits for a given firm's innovation when rivals reveal more information after the AIPA. However, Kim and Valentine (2020) show that firms with shorter (not longer) grant lags generate more disclosure spill-in as a result of the AIPA. Hence, such disclosure benefits work in the opposite direction and would be dominated by our mechanism.

To test the impact of mandated disclosure due to the AIPA on price informativeness, we follow Chen, Goldstein, and Jiang (2007) and construct price synchronicity using the R^2 from a regression of firm i's daily stock returns in quarter t on a constant, the CRSP value-weighted market return, and the return of the three-digit SIC industry portfolio. A firm-quarter's R^2 is set to missing if it is estimated with fewer than 30 daily observations. Since the theory is about a change in firm-specific information impounded in prices, in our empirical exercises, we measure stock return non-synchronicity using $1 - R^2$. Durnev, Morck, Yeung, and Zarowin (2003) find that firms with high stock price non-synchronicity are associated with a stronger predictive ability of current stock returns for future earnings, consistent with the fact that the current stock price reflects more firm-specific information. There is also evidence suggesting that stock price informativeness is linked to the efficiency of corporate resource allocations. For instance, Chen, Goldstein, and Jiang (2007) use stock price non-synchronicity as a measure of private information incorporated in stock prices and find that investment responds more to stock prices when stock return non-synchronicity is higher.

Table 9 reports the results from estimating Eq. (1) with the dependent variable replaced by stock price non-synchronicity. The mean (standard deviation) of $1 - R^2$ is 0.81 (0.19), indicating that, on average, the market and industry returns account for approximately 19% of firms' return variations. This number is very similar to that reported in Chen, Goldstein, and Jiang (2007). Column 1 presents estimates using the full sample; the DiD coefficient is positive but not statistically significant. Columns 2-5 then split the sample into firms that are presumably more (less) affected by mandated disclosure due to the AIPA, following the classification scheme from Section 6.5. In columns 2 and 3 of Table 9, we observe that the DiD coefficient is small and insignificant among firms in non-manufacturing industries, while it is large and statistically significant among firms in manufacturing industries. Similarly, columns 4 and 5 show that the DiD coefficient is large and significant for firms that are expected to file patents relative to that of firms that are not.[22] These results provide further support for the main idea in this paper, which is that mandated disclosure plays a significant role in reducing agency costs and thereby increases the incentives for informed trading by market participants. Importantly, this differs from other studies on the link between corporate disclosures and price

[22] To address the concern raised in Gassen, Skaife, and Veenman (2020) regarding the relationship between R^2 as a measure to identify firm-specific information flows and liquidity, in the Appendix, Table A7, we follow their suggestion and control for liquidity in a nonlinear fashion using dummies for deciles of turnover. This yields qualitatively similar results. Given the bounded nature of $1 - R^2$, we also show that our results remain robust when using the logistic transformation of $1 - R^2$.

informativeness, as we focus on the period prior to the actual release of information.

[Table 9 here]

7. Conclusion

This paper exploits the AIPA as a regulatory event that imposed mandated disclosure on firms that file patents. It allows us to examine the agency cost-related mechanism provided by mandated disclosure on institutional investors' preferences. It also enables us to isolate other potential economic consequences of disclosure that may impact institutions' investment decisions. We observe an increase in institutional ownership during the period leading up to the release of information (the ex ante impact) and that this increase is concentrated among firms with weaker internal and external monitoring mechanisms. We also examine the impact of mandated disclosure on corporate insiders, namely, blockholders, and find that blockholders reduce the size of their stake if exit costs are sufficiently low. Furthermore, we document that the information content of stock prices increases for those firms more affected by the AIPA, even absent actual disclosure. Overall, our results are consistent with the hypothesis that mandated disclosure serves an important governance role that impacts investors' trading preferences.

While a welfare assessment is well beyond the scope of this paper, our findings should cause academics and policymakers to question the basis of mandated disclosure regulations. Indeed, although Mahoney (1995) argued decades ago that the main benefit from mandated disclosure is to resolve agency problems, much of the academic literature and disclosure regulations are based on the premise that it narrows the information gap between informed investors and their uninformed counterparts. However, if resource diversion is inefficient and involves welfare losses, then agency-related considerations are key for the justification of mandated disclosure requirements. Furthermore, our findings may provide the basis for reforms in situations in which more public disclosure crowds out private information production and hence negatively affects price informativeness (Goldstein and Yang, 2019). We provide evidence that the threat of disclosure can be sufficient to incentivize desirable behaviors, and hence, it is possible that adequate disclosure regulations can significantly mitigate the risks of unintended consequences.

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Figures

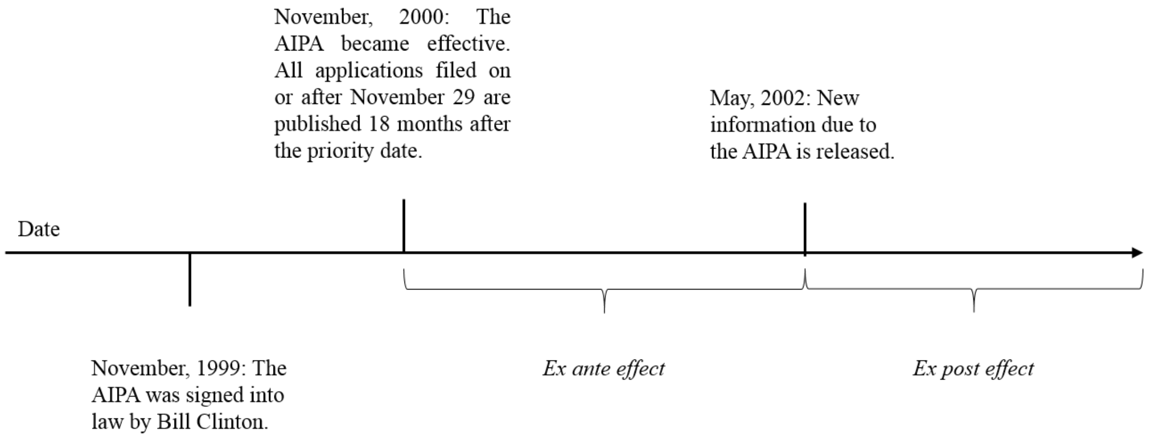

Fig. 1. Timeline of the AIPA. This figure illustrates the AIPA timeline and how it allows us to examine the ex ante (vs. ex post) impact of mandated patent disclosure on institutional investors' preferences.

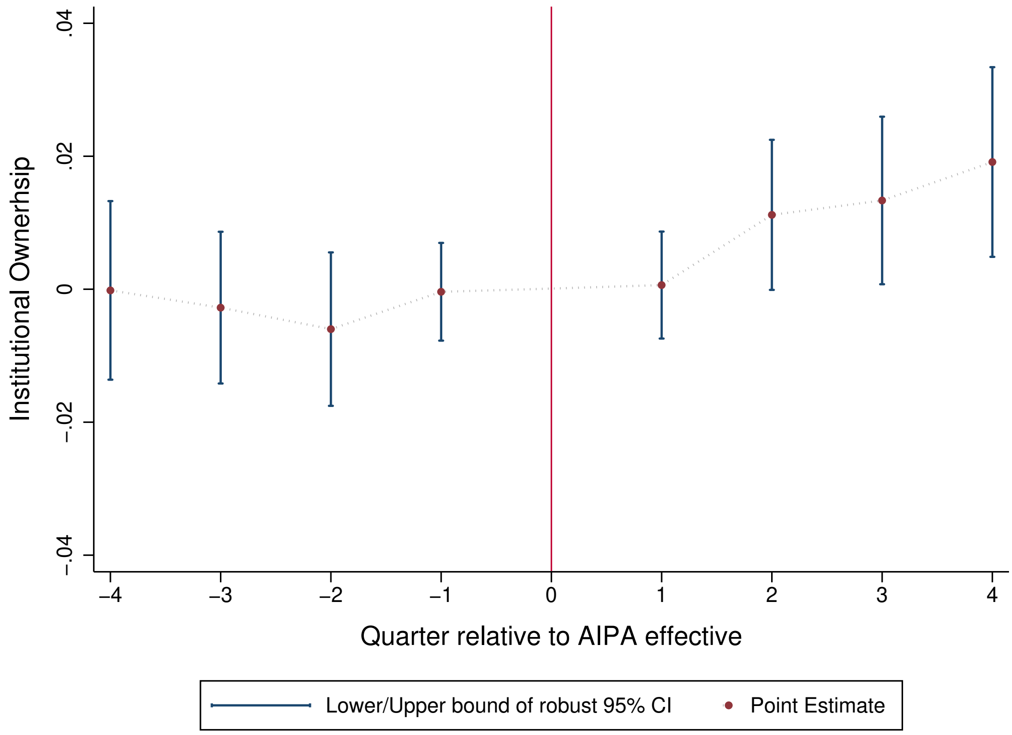

Fig. 2. Institutional ownership around the AIPA. This figure shows a visual DiD examination of the effect of mandated patent disclosure on institutional ownership for firms in the top and the bottom quartile of the distribution of the pre-AIPA delay measure. On the y-axis, the graph plots the institutional ownership ratio; the x-axis shows the time relative to the quarter when the AIPA became effective (ranging from four quarters prior to the AIPA until four quarters after the AIPA). The bars in the figure correspond to the 95% confidence intervals of the coefficient estimates; the confidence intervals are based on robust standard errors that are clustered by firm.

Tables

Table 1
Treatment intensity and other industry characteristics.

Dependent Variable: Treatment Estimation Method: OLS	(1)	(2)	(3)	(4)	(5)
Number of patents filed	0.000				
	(0.000)				
Average citations per patent		-0.001			
		(0.003)			
Product market competition			0.375		
(Herfindahl index)			(0.390)		
Average total factor productivity				0.465	
				(0.516)	
Industry returns					0.028
					(0.081)
N	49	49	49	49	49

This table reports cross-sectional OLS regression results at the (two-digit SIC) industry level. Robust standard errors are in parentheses. The dependent variable, *Treatment*, is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. The independent variables are measured either as total or average values between 1996 and 2000. *Number of patents filed* is the total number of patents filed in a given two-digit SIC industry. *Average citations per patent* is the average number of (truncation-adjusted) forward citations received in a given two-digit SIC industry. *Product market competition* is the Herfindahl index calculated as sum of sales revenue scaled by sales in a given two-digit SIC industry. *Average total factor productivity* is calculated at the two-digit SIC industry level using data from Imrohoroglu and Tuzel (2014). *Industry returns* are the two-digit SIC industry-level return, equally weighted across firms, from 1996 to 2000. Public-service firms are dropped.

Table 2
Summary statistics.

	Mean	StdDev	10%	25%	Median	75%	90%	Observation
Institutional Ownership	0.372	0.274	0.023	0.117	0.343	0.611	0.758	22,375
Ownership Concentration	0.224	0.223	0.038	0.059	0.135	0.315	0.546	21,551
Ownership Breadth	0.044	0.072	0.002	0.005	0.017	0.054	0.107	22,375
Ownership by Gray Investors	0.086	0.090	0.002	0.011	0.057	0.138	0.210	22,375
Ownership by Independent investors	0.285	0.213	0.013	0.088	0.264	0.453	0.591	22,375
Blockholder Ownership	0.133	0.134	0.000	0.000	0.100	0.212	0.323	22,375
Size (L)	5.042	2.156	2.357	3.438	4.870	6.477	7.862	22,375
Turnover (L)	-2.591	1.238	-4.193	-3.346	-2.530	-1.770	-1.078	22,375
Volatility (L)	-1.678	0.538	-2.342	-2.070	-1.699	-1.327	-0.984	22,375
Sales Growth	0.032	0.084	-0.050	-0.010	0.023	0.064	0.122	22,375
$\text{Momentum}_{-3,0}$	0.091	0.519	-0.356	-0.171	0.009	0.233	0.565	22,375
$\text{Momentum}_{-12,-3}$	0.174	1.098	-0.600	-0.338	-0.045	0.328	0.990	22,375
Age (L)	3.678	0.865	2.565	2.996	3.555	4.304	4.828	22,375
Yield (L)	0.007	0.026	0.000	0.000	0.000	0.000	0.023	22,375
M/B (L)	0.647	1.072	-0.603	-0.080	0.547	1.286	2.069	22,375
ROA	0.063	0.217	-0.160	0.028	0.111	0.175	0.240	22,375
R&D (L)	0.051	0.095	0.000	0.000	0.003	0.068	0.157	22,375
S&P 500	0.089	0.284	0.000	0.000	0.000	0.000	0.000	22,375

This table reports summary statistics for variables constructed based on the sample of U.S. publicly traded firms from 1999 Q4 – 2001 Q4. The unit of observation is the firm-quarter level. See Table A2 in the Appendix for variable definitions.

Table 3
Mandated patent disclosure and institutional ownership.

Estimation Method Dependent Variable	OLS $L(\frac{IOR}{1-IOR})$ (1)	OLS $L(\frac{IOR}{1-IOR})$ (2)	Tobit IOR (3)	Tobit IOR (4)	OLS IOR (5)	OLS IOR (6)	OLS IOR (7)
Treatment X Post		0.353***		0.043***		0.044***	0.037***
		(0.122)		(0.015)		(0.015)	(0.012)
Treatment	-0.098	-0.268*	-0.011	-0.032	-0.011	-0.032	
	(0.142)	(0.151)	(0.020)	(0.021)	(0.020)	(0.021)	
Size (L)	0.625***	0.625***	0.090***	0.090***	0.089***	0.089***	0.057***
	(0.019)	(0.019)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Turnover (L)	0.364***	0.364***	0.058***	0.058***	0.058***	0.058***	0.006***
	(0.024)	(0.024)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
$\text{Momentum}_{-3,0}$	-0.240***	-0.239***	-0.034***	-0.034***	-0.033***	-0.033***	-0.019***
	(0.024)	(0.024)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
$\text{Momentum}_{-12,-3}$	-0.101***	-0.100***	-0.016***	-0.015***	-0.015***	-0.015***	-0.004***
	(0.011)	(0.011)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Volatility (L)	-0.660***	-0.663***	-0.088***	-0.089***	-0.087***	-0.088***	-0.015***
	(0.050)	(0.050)	(0.007)	(0.007)	(0.007)	(0.007)	(0.005)
Age (L)	-0.061**	-0.061**	0.001	0.001	0.001	0.001	0.080***
	(0.026)	(0.026)	(0.004)	(0.004)	(0.004)	(0.004)	(0.015)
Yield (L)	0.600	0.608	-0.004	-0.003	-0.008	-0.007	0.006
	(0.452)	(0.454)	(0.062)	(0.062)	(0.061)	(0.061)	(0.050)
M/B (L)	-0.301***	-0.300***	-0.030***	-0.030***	-0.029***	-0.029***	0.008***
	(0.024)	(0.024)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
ROA	0.894***	0.897***	0.108***	0.109***	0.107***	0.108***	-0.003
	(0.123)	(0.123)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)
R&D (L)	1.459***	1.463***	0.035	0.036	0.026	0.027	-0.063*
	(0.264)	(0.264)	(0.032)	(0.032)	(0.032)	(0.032)	(0.037)
Sales Growth	-1.025***	-1.021***	-0.142***	-0.141***	-0.140***	-0.140***	-0.007
	(0.215)	(0.215)	(0.028)	(0.028)	(0.028)	(0.028)	(0.013)
S&P 500	-1.233***	-1.233***	-0.143***	-0.143***	-0.139***	-0.139***	0.015
	(0.084)	(0.084)	(0.014)	(0.014)	(0.013)	(0.013)	(0.014)
Firm FE	No	No	No	No	No	No	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	21,551	21,551	22,375	22,375	22,375	22,375	22,375
Firms	3,506	3,506	3,558	3,558	3,558	3,558	3,558

This table reports OLS and Tobit panel regression results of mandated patent disclosure due to the AIPA on firms' institutional ownership ratio (*IOR*). The unit of observation is the firm-quarter level. The time period is 1999 Q4 – 2001 Q4. Robust standard errors are clustered by firm (in parentheses). *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4. See Table A2 in the Appendix for variable definitions. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 4
Falsification tests and excluding high-tech industries.

Sample Dependent Variable Estimation method: OLS	AIPA in 1997 Q4 IOR (1)	AIPA in 1998 Q4 IOR (2)	AIPA in 1999 Q4 IOR (3)	All CAPX (4)	All PPE (5)	All AQC (6)	All SPPE (7)	All SIV (8)	Excluding High Tech IOR (9)
Treatment X Post	0.004	0.015	-0.020	-0.006	-0.005	-0.007	0.000	-0.001	0.026**
	(0.012)	(0.013)	(0.014)	(0.004)	(0.009)	(0.005)	(0.001)	(0.003)	(0.012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	24,130	24,243	23,451	22,375	22,375	22,375	22,375	22,375	17,343
Firms	3,865	3,904	3,728	3,558	3,558	3,558	3,558	3,558	2,698

This table reports OLS panel regression results of placebo periods and mandated patent disclosure due to the AIPA on firms' institutional ownership ratio (*IOR*), capital expenditures (*CAPX*; Compustat Quarterly Item #90), property, plant, and equipment (*PPE*; #42), acquisitions expenditures (*AQC*; #94), sale of property, plant, and equipment (*SPPE*; #83), and the sale of other investments (*SIV*; #85). The unit of observation is the firm-quarter level. The time periods are as follows: 1996 Q4 – 1998 Q4 (column 1), 1997 Q4 – 1999 Q4 (column 2), 1998 Q4 – 2000 Q4 (column 3), and 1999 Q4 – 2001 Q4 (columns 4 – 9). Robust standard errors are clustered by firm (in parentheses). *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the placebo post-periods in columns 1 to 3, and for the post-AIPA period after 2000 Q4 in all other columns. Column 9 excludes all high-tech firms from the sample which, following Ljungqvist and Wilhelm (2003), are active in the following (four-digit) SIC industries: 3571, 3572, 3575, 3577, 3578 (computer hardware), 3661, 3663, 3669 (communications equipment), 3674 (electronics), 3812 (navigation equipment), 3823, 3825, 3826, 3827, 3829 (measuring and controlling devices), 4899 (communication services), and 7370, 7371, 7372, 7373, 7374, 7375, 7378, and 7379 (software). See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbol ** indicates significance at the 5% level.

Table 5

Confounding events: Regulation Fair Disclosure and decimalization.

Dependent Variable: IOR Sample Estimation Method: OLS	Non-Covered (1)	Covered (2)	Low Coverage (3)	High Coverage (4)	Low Share Turnover (5)	High Share Turnover (6)	Low B/A Spread (7)	High B/A Spread (8)	Low PIN (9)	High PIN (10)	Disclosure Event 1998 Q2 (11)
Treatment X Post	0.034*	0.036**	0.044***	0.027*	0.041***	0.030	0.026*	0.047**	0.040**	0.025	0.027*
	(0.019)	(0.014)	(0.017)	(0.015)	(0.015)	(0.028)	(0.014)	(0.021)	(0.016)	(0.016)	(0.016)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5,836	15,520	10,417	10,939	10,878	10,478	10,862	10,018	10,887	10,446	23,155
Firms	886	2,272	1,579	1,579	1,579	1,579	1,543	1,546	1,578	1,577	3,244

This table reports OLS panel regression results of mandated patent disclosure due to the AIPA on firms' institutional ownership ratio (*IOR*) by splitting the sample according to different measures. It also shows results for an alternative mandated patent disclosure event: the announcement to make all patent and trademark information publicly available through the USPTO's website in June, 1998. The unit of observation is the firm-quarter level. The time periods are as follows: 1999 Q4 – 2001 Q4 (columns 1 – 10) and 1997 Q2 – 1999 Q2 (column 11). Robust standard errors are clustered by firm (in parentheses). *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4 in columns 1 to 10 and for the 1998 disclosure event post-period after 1998 Q3 in column 11. In column 1, we split the sample according to whether a firm has any analysts following in the pre-AIPA period. In columns 3 – 10, we split the sample by the median values of the following variables in the pre-AIPA period: analyst coverage (columns 3 and 4), share turnover (columns 5 and 6), relative bid-ask spreads (columns 7 and 8) and the probability of informed trading (columns 9 and 10). Analyst coverage data are from the Institutional Brokers Estimates System (I/B/E/S) files, bid-ask spreads from Farshid Abdi's website (http://www.farshidabdi.net/data/), and probability of informed trading data from Stephen Brown's website (http://scholar.rhsmith.umd.edu/sbrown/pin-data). See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 6
Mandated patent disclosure, ownership structure and institutional investor types.

	Panel A: Ownership Structure		Panel B: Ownership Type			
Sample	All	All	All	All	All	High Share Turnover
Dependent Variable	Ownership Concentration	Ownership Breadth	Grey Investors	Independent Investors	Blockholder	Blockholder
Estimation Method: OLS	(1)	(2)	(3)	(4)	(5)	(6)
Treatment X Post	-0.033**	0.003**	0.003	0.032***	-0.008	-0.074*
	(0.014)	(0.001)	(0.005)	(0.011)	(0.012)	(0.038)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
N	21,551	22,375	22,375	22,375	22,375	5,134
Firms	3,506	3,558	3,558	3,558	3,558	789

This table reports OLS panel regression results of mandated patent disclosure due to the AIPA on alternative institutional ownership outcomes. The unit of observation is the firm-quarter level. The time period is 1999 Q4 – 2001 Q4. Robust standard errors are clustered by firm (in parentheses). *Ownership concentration* is the Herfindahl index using institutional ownership (column 1). *Ownership breadth* is the fraction of the number of institutional investors that have reported ownership to the total number of institutional owners reporting in a given quarter (column 2). *Grey investors* is the fraction of shares held by banks, insurance companies, corporate pension funds, university and foundation endowments, and miscellaneous (column 3). *Independent investors* is the fraction of shares held by independent investment advisors, investment companies and private pension funds (column 4). Institutional investor classification data are from Brian Bushee's website (http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html). More details for the rationale for this classification are provided in Chen, Harford, and Li (2007). *Blockholders* is the fraction of shares held by institutions with at least five percent of the shares (columns 5 and 6). Column 6 restricts the sample to those stocks in the top quartile in share turnover in the pre-AIPA period. *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4. See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbols *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table 7
Treatment intensities across industries and patenting firms.

Dependent Variable: IOR Sample Estimation Method: OLS	Non-Manufacturing Firms (1)	Manufacturing Firms (2)	Non-Patenting Firms (3)	Patenting Firms (4)
Treatment X Post	0.022	0.083***	0.019	0.120***
	(0.014)	(0.023)	(0.013)	(0.026)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
N	10,428	11,947	13,255	9,120
Firms	1,737	1,821	2,182	1,376

This table reports OLS panel regression results of mandated patent disclosure due to the AIPA on firms' institutional ownership ratio (*IOR*) by splitting the sample according to whether firms are operating in manufacturing industries (SIC codes 2000 – 3999) and obtained any patent in the period between 1996 and 2000. The unit of observation is the firm-quarter level. The time period is 1999 Q4 – 2001 Q4. Robust standard errors are clustered by firm (in parentheses). *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4. See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbol *** indicates significance 1% level.

Table 8

Treatment intensities across internal monitoring effectiveness.

Dependent Variable: IOR Sample Estimation Method: OLS	Low Firm-specific Knowledge (1)	High Firm-specific Knowledge (2)	Low Board Independence (3)	High Board Independence (4)	Low Managerial Power (5)	High Managerial Power (6)	Low Managerial Ownership (7)	High Managerial Ownership (8)
Treatment X Post	0.013	0.122***	0.063**	0.026	0.011	0.065**	0.023	0.070**
	(0.013)	(0.024)	(0.026)	(0.022)	(0.030)	(0.030)	(0.027)	(0.028)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,641	10,715	2,564	2,821	2,499	3,010	2,499	2,437
Firms	1,579	1,579	365	386	353	416	336	336

This table reports OLS panel regression results of mandated patent disclosure due to the AIPA on firms' institutional ownership ratio (*IOR*) by splitting the sample according to median values of the following measures in the pre-AIPA period: the ratio of R&D to total assets (columns 1 and 2), the ratio of the number independent directors to board size (columns 3 and 4), the number of years the CEO held that position (columns 5 and 6) and the fraction of shares held by the CEO (columns 7 and 8). The unit of observation is the firm-quarter level. The time period is 1999 Q4 – 2001 Q4. Robust standard errors are clustered by firm (in parentheses). *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4. R&D (Item #46) and total assets (#6) come from the Compustat Annual file, information on director characteristics from the Investor Responsibility Research Center (IRRC) database, and CEO ownership and tenure data from the Compustat Executive Compensation (ExecuComp) file. See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbols ** and *** indicate significance at the 5% and 1% level, respectively.

Table 9
Mandated patent disclosure and price non-synchronicity.

Dependent Variable: $1 - R^2$ Sample Estimation Method: OLS	 All (1)	Non-Manufacturing Firms (2)	Manufacturing Firms (3)	Non-Patenting Firms (4)	Patenting Firms (5)
Treatment X Post	0.019	-0.012	0.100**	-0.019	0.132***
	(0.025)	(0.030)	(0.048)	(0.028)	(0.048)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
N	22,233	10,356	11,877	13,155	9,078
Firms	3,546	1,727	1,819	2,173	1,373

This table reports OLS panel regression results of mandated patent disclosure due to the AIPA on stock price non-synchronicity ($1 - R^2$). Columns 2 – 4 split the sample according to whether firms are operating in manufacturing industries (SIC codes 2000 – 3999) and obtained any patent in the period between 1996 and 2000. The unit of observation is the firm-quarter level. The time period is 1999 Q4 – 2001 Q4. Robust standard errors are clustered by firm (in parentheses). R^2 comes from a regression of firm i's daily stock returns in quarter t on a constant, the CRSP value-weighted market return and the return of the three-digit SIC industry portfolio. A firm-quarter's R^2 is set to missing if it is estimated with fewer than 30 daily observations. *Treatment* is the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. *Post* is a dummy variable for the post-AIPA period after 2000 Q4. See Table 3 for control variables and Table A2 in the Appendix for definitions. The symbols ** and *** indicate significance at the 5% and 1% level, respectively.

Appendix for
"Mandated disclosure, institutional investors and stock price informativeness: Evidence from a quasi-natural experiment"

This appendix provides additional material and robustness tests to accompany the main article. Table A1 lists all two-digit Standard Industrial Classification (SIC) industries, their average delays from filing to grant, and the associated number of firm-year observations and firms in our sample. Table A2 defines the variables used for the baseline analysis and lists their sources. Tables A3-A7 present additional difference-in-difference regression results surrounding the passage of the AIPA. The results are discussed in the main article.

- Table A3 shows the difference-in-difference regression results on a balanced panel, in which we require firms to be in the sample over the entire pre- and post-AIPA period.
- Table A4 shows the difference-in-difference regression results when clustering standard errors at the SIC2 industry level.
- Table A5 shows the difference-in-difference regression results after dropping all control variables and when using alternative treatment definitions.
- Table A6 shows the difference-in-difference regression results when using alternative pre- and post-period contrasts.
- Table A7 shows the difference-in-difference regression results when allowing for a more flexible functional form of the relation between liquidity and $1 - R^2$ and using the logistic transformation of $1 - R^2$.

Table A1
Industry-level (two-digit SIC) treatment.

SIC 2	Label	Mean delay	Observations	Firms
01	Agricultural Production - Crops	2.331	59	10
10	Metal Mining	2.064	79	11
13	Oil and Gas Extraction	2.053	896	135
14	Mining and Quarrying of Nonmetallic Minerals. Except Fuels	1.976	47	6
15	Construction - General Contractors & Operative Builders	2.021	204	30
16	Heavy Construction. Except Building Construction. Contractor	2.173	61	12
20	Food and Kindred Products	2.068	634	98
21	Tobacco Products	2.532	20	4
22	Textile Mill Products	1.924	163	27
23	Apparel. Finished Products from Fabrics & Similar Materials	2.137	268	42
24	Lumber and Wood Products. Except Furniture	2.229	176	24
25	Furniture and Fixtures	2.045	150	21
26	Paper and Allied Products	2.106	238	34
27	Printing. Publishing and Allied Industries	2.234	315	47
28	Chemicals and Allied Products	2.211	1,989	315
29	Petroleum Refining and Related Industries	2.054	141	23
30	Rubber and Miscellaneous Plastic Products	2.035	297	45
31	Leather and Leather Products	1.980	110	15
32	Stone. Clay. Glass. and Concrete Products	2.029	143	25
33	Primary Metal Industries	2.052	385	54
34	Fabricated Metal Products	2.037	408	60
35	Industrial and Commercial Machinery and Computer Equipment	2.241	1,648	254
36	Electronic & Other Electrical Equipment & Components	2.191	2,157	320
37	Transportation Equipment	1.987	569	85
38	Measuring. Photographic. Medical. & Optical Goods. & Clocks	2.173	1,843	281
39	Miscellaneous Manufacturing Industries	1.925	293	47
40	Railroad Transportation	2.233	93	12
42	Motor Freight Transportation	2.437	295	44
44	Water Transportation	1.341	74	10
45	Transportation by Air	2.465	202	28
48	Communications	2.340	544	106
50	Wholesale Trade - Durable Goods	2.122	678	106
51	Wholesale Trade - Nondurable Goods	2.504	391	63
53	General Merchandise Stores	2.536	47	7
55	Automotive Dealers and Gasoline Service Stations	2.200	135	21
56	Apparel and Accessory Stores	1.852	67	10
57	Home Furniture. Furnishings and Equipment Stores	2.322	71	15
58	Eating and Drinking Places	2.150	467	72
59	Miscellaneous Retail	1.892	346	65
70	Hotels. Rooming Houses. Camps. and Other Lodging Places	2.089	144	23
72	Personal Services	2.130	75	11
73	Business Services	2.268	3,492	619
75	Automotive Repair. Services and Parking	2.003	71	13
78	Motion Pictures	1.892	109	20
79	Amusement and Recreation Services	2.223	262	41
80	Health Services	2.598	529	80
82	Educational Services	2.225	105	20
87	Engineering. Accounting. Research. and Management Services	2.243	577	94
99	Nonclassifiable Establishments	2.079	308	53

This table reports for each two-digit SIC industry the mean difference (in years) between the filing date and the grant date, across all patents granted to publicly traded firms in the respective industry between 1996 and 2000, the total number of observations, and the total number of firms in our sample.

Table A2
Definitions of variables.

Variable	Definition	Sources
Institutional Ownership Ratio	Ratio of shares held by institutions to shares outstanding	CDA/Spectrum, CRSP
Institutional Ownership Concentration	Institutional Herfindahl index calculated using institutional ownership	CDA/Spectrum, CRSP
Institutional Ownership Breadth	Fraction of the number of institutional investors that have reported ownership to the total number of institutional owners reporting in a the filing quarter	CDA/Spectrum
Ownership by Independent Investors	Ratio of shares held by independent institutions (independent investment advisors, investment companies, private pension funds) to shares outstanding	CDA/Spectrum, CRSP, Brian Bushee's website
Ownership by Gray Investors	Ratio of shares held by gray institutions (banks, insurance companies, corporate pension funds, university and foundation endowments, miscellaneous) to shares outstanding	CDA/Spectrum, CRSP, Brian Bushee's website
Blockholder Ownership	Ratio of shares held by all blockholders (defined as holdings by institutions with at least five percent of the shares) to shares outstanding	CDA/Spectrum, CRSP
Size	Market capitalization in millions of dollars	CRSP
Turnover	Ratio of trading volume to shares outstanding, measured in the month prior to the beginning of the filing quarter	CRSP
$\text{Momentum}_{-3,0}$	Percentage return earned in the filing quarter	CRSP
$\text{Momentum}_{-12,-3}$	Percentage return earned during the nine months preceding the filing quarter	CRSP
Volatility	Standard deviation of a firm's monthly returns over a two-year window	CRSP
Age	Number of quarters since the stock's inclusion in the CRSP database	CRSP
Yield	Ratio of cash dividends to market capitalization (item 21/item 25×item 199), measured at the fiscal year-end before the most recent June 30	Compustat Annual
M/B	Ratio of market value of equity (item 25×item 199) to the book value of equity, measured at the fiscal year-end before the most recent June 30; book equity is the book value of stockholder's equity (item 144) minus the book value of preferred stock plus balance-sheet deferred taxes (item 74) and investment tax credits (item 208), where the book value of preferred stock is given by redemption (item 56), liquidation (item 10), or par value (item 130), in that order of availability	Compustat Annual
ROA	Ratio of operating income before depreciation to total assets (item 13/item 6), measured at the fiscal year-end before the most recent June 30	Compustat Annual
R&D	Ratio of research and development expenditures to total assets (item 46/item 6), measured at the fiscal year-end before the most recent June 30	Compustat Annual
Sales Growth	Two-year geometric average of quarterly growth rate in net sales (item 2)	Compustat Quarterly
S&P 500	Dummy variable that takes the value of one if a firm is a member of the Standard & Poor's 500 index, and zero otherwise	CRSP

Table A3

Mandated patent disclosure and institutional ownership: Balanced sample.

Estimation Method	OLS	OLS	Tobit	Tobit	OLS	OLS	OLS
Dependent Variable	$L(\frac{IOR}{1-IOR})$	$L(\frac{IOR}{1-IOR})$	IOR	IOR	IOR	IOR	IOR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment X Post		0.440***		0.053***		0.054***	0.033***
		(0.113)		(0.014)		(0.014)	(0.012)
Treatment	-0.098	-0.319*	-0.010	-0.037	-0.009	-0.036	
	(0.165)	(0.175)	(0.024)	(0.025)	(0.024)	(0.025)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	No	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	16,465	16,465	17,014	17,014	17,014	17,014	17,014
Firms	2,118	2,118	2,136	2,136	2,136	2,136	2,136

This table replicates our baseline regression results from Table 3 in the paper but requires firms to be present in the sample over the entire pre- and post-AIPA period. See the notes to Table 3 for other details. The symbols * and *** indicate significance at the 10% and 1% level, respectively.

Table A4

Mandated patent disclosure and institutional ownership: Clustering errors at the industry level.

Estimation Method	OLS	OLS	Tobit	Tobit	OLS	OLS	OLS
Dependent Variable	$L(\frac{IOR}{1-IOR})$	$L(\frac{IOR}{1-IOR})$	IOR	IOR	IOR	IOR	IOR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treatment X Post		0.353**		0.043*		0.044*	0.037***
		(0.155)		(0.023)		(0.023)	(0.014)
Treatment	-0.098	-0.268	-0.011	-0.032	-0.011	-0.032	
	(0.181)	(0.206)	(0.033)	(0.036)	(0.033)	(0.036)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	No	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	21,551	21,551	22,375	22,375	22,375	22,375	22,375
Firms	3,506	3,506	3,558	3,558	3,558	3,558	3,558

This table replicates our baseline regression results from Table 3 in the paper but clusters robust standard error (in parentheses) at the two-digit SIC industry level instead at the firm level. See the notes to Table 3 for other details. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table A5
Miscellaneous robustness tests.

Dependent Variable: IOR Sample Estimation method: OLS	Excluding Controls (1)	Top 25% vs. Bottom 25% (2)	Median Delay (3)	Excluding Year 2000 (4)	USPC class Delay (5)	Examiner- specific Delay (6)
Treatment X Post	0.037***	0.018***	0.028***	0.031***	0.042***	0.041***
	(0.014)	(0.005)	(0.010)	(0.011)	(0.011)	(0.014)
Controls	No	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
N	22,375	10,557	22,375	22,375	9,177	9,177
Firms	3,558	1,584	3,558	3,558	1,389	1,389

This table replicates our baseline regression results from Table 3 in the paper, excluding all control variables from the right-hand side (column 1) and using alternative treatment definitions (columns 2 to 6). Column 2 uses a discrete industry-level (based on two-digit SIC codes) treatment indicator by sorting firms into quartiles and retains only the top and bottom quartile firms based on the average time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. Column 3 uses the continuous industry-level treatment variable based on the median (instead of the mean) time difference between the filing date and the grant date, across all patents granted to U.S. publicly listed firms between 1996 and 2000. Column 4 uses the continuous industry-level treatment based on average delays from 1995 to 1999, instead of 1996 to 2000. Column 5 conditions on firms having patented at least once between 1996 and 2000, and uses the average (weighted) difference between filing date and grant between 1996 and 2000 based on all technological fields in which the focal firm has been active. Column 6 is based on delays that are specific to the examiner responsible for reviewing firms' patents. See the notes to Table 3 for other details. The symbol *** indicates significance at the 1% level.

Table A6
Mandated patent disclosure and institutional ownership: Alternative sample frames.

Estimation Method: OLS				
Pre-AIPA Period	1999 Q4 - 2000 Q3	1999 Q4 - 2000 Q3	1999 Q4 - 2000 Q3	1999 Q4 - 2000 Q3
Post-AIPA Period	2000 Q4 - 2001 Q3	2001 Q1 - 2002 Q4	2001 Q1 - 2003 Q4	2001 Q1 - 2004 Q4
Dependent Variable: IOR	(1)	(2)	(3)	(4)
Treatment X Post	0.030***	0.045***	0.053***	0.058***
	(0.010)	(0.013)	(0.014)	(0.015)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
N	22,581	33,163	43,409	53,251
Firms	3,552	4,017	4,150	4,269

This table replicates our baseline regression results from Table 3 in the paper but uses alternative post-AIPA periods. All columns keep the pre-AIPA period fixed between 1999 Q4 and 2000 Q3. The post-AIPA periods are as follows: 2000 Q4 – 2001 Q3 (column 1), 2001 Q1 – 2002 Q4 (column 2), 2001 Q1 – 2003 Q4 (column 3), and 2001 Q1 – 2004 Q4 (column 4). See the notes to Table 3 for other details. The symbol *** indicate significance at 1% level.

Table A7
Mandated patent disclosure and price non-synchronicity: Robustness tests.

Dependent Variable	$1-R^2$	$1-R^2$	$1-R^2$	$1-R^2$	$1-R^2$	$L(\frac{1-R^2}{R^2})$	$L(\frac{1-R^2}{R^2})$	$L(\frac{1-R^2}{R^2})$	$L(\frac{1-R^2}{R^2})$	$L(\frac{1-R^2}{R^2})$
Sample	All	Non-Manufacturing Firms	Manufacturing Firms	Non-Patenting Firms	Patenting Firms	All	Non-Manufacturing Firms	Manufacturing Firms	Non-Patenting Firms	Patenting Firms
Estimation Method: OLS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment X Post	0.016	-0.015	0.091*	-0.022	0.128***	0.104	-0.158	0.799**	-0.115	0.790**
	(0.025)	(0.030)	(0.048)	(0.028)	(0.049)	(0.170)	(0.198)	(0.342)	(0.193)	(0.310)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nonlinear controls for liquidity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22,233	10,356	11,877	13,155	9,078	22,233	10,356	11,877	13,155	9,078
Firms	3,546	1,727	1,819	2,173	1,373	3,546	1,727	1,819	2,173	1,373

This table replicates Table 9 in the paper but controls for liquidity in a nonlinear fashion by using dummy variables for deciles of share turnover. We also provide estimates when using the logistic transformation of $1-R^2$ as dependent variable. See the notes to Table 9 for other details. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.