Attracting the Sharks: Corporate Innovation and Securities Class Action Lawsuits

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Keywords: Corporate Governance; Law and Economics; Innovation; Patents; Shareholder Litigation; Class Action Lawsuit

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September 26, 2020

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1 Introduction

A vast body of academic work, from Adam Smith's pin factory to Schumpeter's creative destruction, emphasizes the importance of corporate innovation for economic growth. Consistent with this favorable view of innovation, fostering and promoting corporate innovation has become a core policy objective in governments around the world.

If promoting innovative activity is a desirable societal goal, identifying potential obstacles to the creation and implementation of valuable new ideas is crucially important. This paper presents novel evidence suggesting that certain features of a central pillar of the U.S. litigation and corporate governance system, securities class action lawsuits, constitute such an obstacle. In particular, we show that the class action litigation system imposes disproportionate costs on firms with valuable innovation output, by making these successful innovators particularly vulnerable to low-quality class action litigation.[1] We also show that class action litigation risk affects corporate innovation activity: firms patent less and the economic value of the innovations firms produce decreases after an exogenous increase in class action litigation risk.

The idea that lawyers can abuse the class action system by bringing low-quality cases against innovative firms is widespread and influential. The standard narrative is as follows: because innovation is inherently risky, innovative firms have more volatile stock prices and experience more large stock drops. And since large stock drops are attractive for lawyers who want to claim that a stock has traded at inflated prices because relevant information was withheld from investors, we see more low-quality litigation for innovative firms. This view – which we label the "risky innovation hypothesis" – that large stock drops associated with failed innovation make innovative firms more susceptible to low-quality litigation is influential with lawyers, economists, practitioners, and policy-makers.[2] Most notably, the risky innovation hypothesis was a major motivation behind the Private Securities Litigation Reform Act (PSLRA) of 1995, which was enacted by U.S. Congress in an attempt to reduce abuses of the class action litigation system via low-quality litigation.[3]

[1] We use the term *low-quality lawsuit* to denote lawsuits with little or no legal merit. Law firms may file low-quality cases in an effort to extract a settlement from firms wishing to avoid a costly legal dispute. For our purposes, and unless otherwise indicated, the closely related terms "meritless lawsuits" and "frivolous lawsuits" can be used interchangeably. See Sections 3 and 4 for further details on securities class action lawsuits and the motivations of law firms to file low-quality suits.

[2] See, for example, Alexander (1991) and Seligman (1994) for evidence from the law literature; Lin, Liu, and Manso (2019) for evidence from the economics literature; and U.S. Chamber Institute for Legal Reform (2014), p. 20–21, for evidence from the practitioner and policy-oriented literature.

[3] See, for example, Seligman (2004), p. 96. Senator Donald W. Riegle, Jr. stated in a Senate subcommittee hearing that: *"Companies, particularly growth firms, say they are sued whenever their stock drops."* Moreover, Senator Pete Domenici (one of the two Senators sponsoring the initial bill) stated that *"the race to innovate becomes a race to the courthouse"* and cited the CEO of Silicon Graphics Computers, Edward R. McCracken, who wrote that *"the high-tech firms of Silicon Valley and the Bay Area's bio-tech companies are the No. 1 target of these schemes [of low-quality class actions], because cutting-edge research and the risks inherent in development*

Despite being influential and intuitively appealing, there are two empirical facts which challenge the risky innovation hypothesis. First, the empirical case for a causal relation between innovation and the probability of being target of a low-quality lawsuit in the existing literature is weak. It mostly rests on observing higher litigation rates in some sectors, like the technology sector (e.g., Francis, Philbrick, and Schipper (1994)) – but lawsuits being correlated with industry membership is a far cry from causal evidence that innovation drives litigation. Explicitly emphasizing the latter point, Kim and Skinner (2012) conduct a large-scale investigation into the drivers of class action litigation beyond industry membership and find that R&D expenditures do not predict subsequent litigation. Their results raise fundamental questions about whether corporate innovation links to class action litigation in the first place. Obviously, without such a link, the risky innovation hypothesis is dead. Second, in the average year in our 1996-2011 sample period, 56% of all Compustat firms experience a stock drop of at least 10%, but only 2% of those firms are sued in a class action lawsuit.[4] Given that there are many more stock drops than class action lawsuits, stock drops *per se*—the focal object of the risky innovation hypothesis—provide at best a partial explanation for litigation. Why specific firms get sued *among those that experience stock drops* is a key question, necessary to understand the underlying economics, necessary for sound policy recommendations, and largely unanswered by the risky innovation hypothesis. Overall, our understanding of the relation between corporate innovation and litigation is much more limited than casual observation of the topic may suggest.

The purpose of this paper is to make progress by suggesting a new perspective on the link between innovation and litigation, which we label the "valuable innovation hypothesis." The valuable innovation hypothesis holds that low-quality lawsuits specifically target successful innovators, i.e., firms that have recently received economically valuable patents and are about to embark on implementing their valuable ideas, because such successful firms are attractive targets for low-quality litigation. Several not mutually exclusive reasons can explain why successful innovators are attractive targets, including that managers who are busy growing their firms have high opportunity costs on time and other resources, that growing firms are particularly sensitive to bad publicity, and that successful innovators use more positive and forward-looking communication with investors, which is potentially easier for lawyers to attack. In this study, we provide both theoretical and empirical support for the valuable innovation hypothesis and show it fits the data better than, and overcomes some of the main shortcomings of, the risky innovation hypothesis.

A core conceptual contribution of the valuable innovation hypothesis is to emphasize the distinction between innovation inputs, like R&D expenditures, and innovation outputs, which

make their stock prices volatile" (see Congressional Record Volume 141 (1995)).

[4] The 10% threshold has been argued in Senate hearings to be a common trigger point for class action litigation. See, for example, Seligman (1994) and the references therein.

we measure as the economic value of granted patents in a given firm-year as described in detail below. This distinction allows us to reconcile the fact that practitioners and policy makers perceive innovation to be an important driver of low-quality litigation with the lack of strong evidence for an innovation-litigation link in the existing literature. We show that once we focus on innovation output, there is a strong empirical link between innovation and subsequent low-quality class action litigation. By contrast, if we follow prior work and focus on innovation input, we find no relation between innovation and low-quality litigation, consistent with Kim and Skinner (2012). The valuable innovation hypothesis thus helps us make progress on the first challenge to the risky innovation hypothesis we mentioned above. It also helps us make progress on the second challenge, because the valuable innovation hypothesis makes testable predictions about which firms have an elevated likelihood of being targeted by low-quality lawsuits *conditional* on a stock drop: firms with valuable innovation output.

To measure a firm's innovation output, we rely on an approach recently proposed by Kogan, Papanikolaou, Seru, and Stoffman (2017) (KPSS), who exploit stock-market reactions to new patent grants to determine the private economic value of innovations. The KPSS measure of valuable innovation output is ideal for our purpose because it is a strong predictor of subsequent growth in employment, capital, output, profits, and revenue-based total factor productivity. As shown by KPSS, this feature sets their measure apart from various other measures of innovation output and innovation input used in the prior literature. Hence, if innovation-induced firm growth makes innovative firms more attractive litigation targets, as predicted by the valuable innovation hypothesis, then the KPSS measure should allow us to pick up this relationship. We check other measures for robustness.

We address potential endogeneity concerns using a range of different approaches. First, we show that the probability of a subsequent low-quality class action lawsuit increases in current innovation value also when controlling for a rich set of variables which have been shown by Kim and Skinner (2012) to predict shareholder litigation, including firm size, sales growth, stock returns, volatility, skewness, and turnover. In particular, we also control for innovation input using R&D expenditures and find that, while innovation output links strongly with subsequent lawsuits, innovation inputs do not. Second, we exploit information about how innovation affects not only low-quality lawsuits, but also high-quality lawsuits, and all lawsuits. While the valuable innovation hypothesis is consistent with the broader set of patterns, several alternative stories are not. For example, the hypothesis that innovative firms may simply have better lawyers is inconsistent with our finding that the probability of high-quality lawsuits does not decrease in innovation, and the finding that the overall probability of any lawsuit (i.e., both high and low-quality) increases. Third, we can include firm fixed effects in our regressions, which rule out that time-invariant characteristics of the firm, such as firm culture, are driving the documented relationship. Fourth, we show that the results are robust to using ex-ante proxies for lawsuit quality, as well as to alternative measures of innovation output. Fifth, we show that our results also obtain when we consider instruments for valuable innovation output. Finally, we estimate a dynamic version of our model, which shows that the timing of the effects supports a direct link between valuable innovation and subsequent low-quality litigation.

On top of making a lawsuit more likely, we find that valuable innovation is associated with greater losses to shareholders conditional on a low-quality class action lawsuit being filed. A one-standard-deviation increase in valuable innovation is associated with an additional 1.4 percentage-point decrease in the targeted firm's market capitalization in the seven days around a low-quality class action lawsuit filing. Combined, these findings imply that more valuable innovation output is associated with both, a greater probability of being subject to a low-quality class action lawsuit, and a greater loss conditional on receiving such a lawsuit. The expected costs of low-quality class action lawsuits are thus particularly high for firms with the highest innovation output. This finding is significant, because it implies that, *ex post*, low-quality litigation systematically drains resources from those firms with the most valuable ideas.

With respect to potential drivers of these patters, we show that our findings cannot be explained by the risky innovation hypothesis, or by any other theory that focuses on innovation-induced stock price drops. Contrary to the predictions of these theories, firms with valuable innovation output in a given year are not associated with an increased likelihood of a stock drop next year, and their volatility *decreases* in the year following a valuable patent grant.

In the second part of the paper, we ask whether the threat of innovation-induced class action litigation, as established in the first part of our paper, also affects firms' innovation choices *ex ante*. Even though litigation costs are economically sizable ex post, this is ultimately an empirical question. To tackle it, we follow the approach by Huang, Hui, and Li (2019) and exploit changes in the expected business-friendliness of judge panels in federal circuit courts as exogenous determinants of class action litigation risk. We find that an increase in shareholder class action litigation risk leads firms to patent less and decreases the value of firms' innovation output.

In sum, we advance a novel perspective on understanding the economic link between corporate innovation and class action lawsuits. In particular, our findings suggest that low-quality lawsuits are targeted at, lead to economically sizeable losses for, and distort the innovation decisions of highly innovative firms, which raises many important questions for managers, lawyers, judges, and policy makers. A key new insight we propose is that, to understand the link between innovation and low-quality class action litigation, we need to think beyond innovation risk and innovation failure which were emphasized in prior work. It is innovation output, not innovation input, which drives subsequent low-quality litigation. More broadly, by providing new, large-scale evidence on the innovation-litigation link, our findings contribute to the ongoing debate on whether securities class action lawsuits have adverse effects on the competitiveness of the U.S. economy.

2 Relation to the Existing Literature

Our paper contributes to the literature on the economic consequences of the U.S. class action litigation system. One strand of this literature focuses on the incidence, discovery, and cost of true frauds, i.e., high-quality, meritorious, class action lawsuits.[5] Because we focus on low-quality class action lawsuits, i.e., lawsuits with little or no legal merit, our paper is different and complements the previous findings for meritorious lawsuits. A second strand of this literature focuses on low-quality class actions and their impact on the economy. Zingales (2006) argues that the class action litigation system in the U.S. leads to a loss of competitiveness of U.S. public equity markets. Spiess and Tkac (1997) and Johnson, Kasznik, and Nelson (2000) study selected industries to show that market valuations of firms that are more likely to be target of meritless class action lawsuits increase around the introduction of the Private Securities Litigation Reform Act (PSLRA), which is consistent with meritless suits being costly to shareholders.[6] These papers do not investigate how innovation affects the incidence and shareholder wealth losses associated with low-quality litigation, which is what we analyze in our paper.

Our findings on the link between innovation output and class action litigation risk accord well with the observation in prior work that some industries, most notably the technology sector, have particularly high class action litigation rates (e.g., Francis, Philbrick, and Schipper (1994), Kasznik and Lev (1995), Field, Lowry, and Shu (2005), Crane and Koch (2018)). However, it is important to note that we are making a new point, not subsumed by this prior literature. Conceptually, the reason is that many factors could drive an observed relation between industry membership and litigation rates, and that, as a result, it is not possible to conclude from observing higher litigation rates in, for example, the technology industry, that corporate innovation drives litigation. Correlation is not causation and therefore none of the above papers makes the claim that innovation causes higher litigation rates. Empirically, we go beyond this work above in three important ways. First, we identify the effect of corporate innovation using variation within industry-dates, which implies that our findings are orthogonal to industry membership. Second, we show that distinguishing between innovation input and output is crucial for understanding

[5]Papers in this literature include Karpoff, Lee, and Martin (2008), Gande and Lewis (2009), Wang, Winton, and Yu (2010), Dyck, Morse, and Zingales (2010), and Dyck, Morse, and Zingales (2017).

[6]Ali and Kallapur (2001) challenge some of the conclusions in these two studies. Whether or not PSLRA was successful in its stated aims remains a topic of scientific debate (e.g., Klock (2016), Choi (2007)). A summary of work on low-quality litigation before the introduction of PSLRA in 1995 can be found in Choi, Pritchard, and Fisch (2005).

the relation between innovation and class action litigation, a point which, to the best of our knowledge, is new to this literature. Third, we show that class action litigation risk affects firms' innovation decisions.

Our paper is related to, and builds upon, the work of Kim and Skinner (2012), who emphasize that industry indicators tell us little about why firms become targets of class action lawsuits. They propose a range of firm-specific variables to augment industry membership in standard firm-level regressions used to predict class action lawsuits. We derive our results from regressions that include their proposed variables as controls. Kim and Skinner (2012) find that innovation inputs (i.e., R&D expenditures) do not explain subsequent class action litigation. Their finding provides a motivation for our study and the valuable innovation hypothesis we advance in this paper.

While our paper focuses on shareholder class action lawsuits, our work is related to a set of studies which establish adverse effects of the litigation system on innovative firms in other settings. Lin, Liu, and Manso (2019) use a natural experiment to show that innovative activity increases when the threat of shareholder derivative lawsuits in state-courts decreases. Our study differs from theirs in several respects. First, they study a different type of lawsuit, state-level derivative suits, so their results do not imply ours and vice versa. Prior research argues that, relative to federal class action lawsuits, derivative lawsuits in state courts (i) "generally cover a narrow range of misbehavior, that is, almost entirely limited to two contexts–acquisitions and self-dealing transactions"; (ii) "carry less severe penalties and are of diminishing importance"; and (iii) "typically follow the filing of a federal securities class action suit" (see Huang, Hui, and Li (2019), footnote 1 and the references therein). Second, they use state-level changes in universal demand laws to obtain variation in the risk of being sued in a derivative suit. As they show, those law-changes affect derivative suits, but not class actions. By contrast, for the last set of tests in our paper, we obtain identification from judge turnover in federal circuit courts, which affects class actions but not derivative suits. Third, while their results show that changes in derivative-litigation risk affects innovation, they do not show (and their results do not imply) that innovation causes litigation, which is the focus of our study (in our different legal context). Other studies have focused on patent litigation. Cohen, Gurun, and Kominers (2016) document a sharp rise in patent litigation by nonpracticing entities in the United States between 2005 and 2015. In addition, Cohen, Gurun, and Kominers (2019) provide evidence that non-practicing entities appear to act as "patent trolls," targeting cash-rich firms irrespective of actual patent infringement, and subsequently reduce innovative activity at targeted firms. Mezzanotti (2020) shows that stronger patent enforcement can reduce the negative effects of patent litigation on corporate innovation.

Combined, these studies and ours highlight the adverse effects of the litigation system on innovative activity across a broad spectrum of important, but distinct, subspaces of the litigation universe. Jointly, they provide some empirical support for a concern raised by a number of CEOs in a survey conducted by McKinsey for the city of New York in 2007. These CEOs felt that "*the legal environment is detrimental to America's spirit of entrepreneurialism and innovation*" (McKinsey & Company (2007)).

3 Securities Class Action Lawsuits in the U.S.

Private securities class action lawsuits are a central pillar of the U.S. litigation and corporate governance system. According to data from the Stanford Securities Class Action Clearinghouse (SCAC), about 5,000 class actions were filed between 1996 and 2017, and close to 40% of all companies listed on major U.S. stock exchanges have been targeted by a securities class action lawsuit at least once during that period. The upper graph in Figure 1 shows the annual number of securities class action lawsuits from 1996. Given that securities class action lawsuits are so prevalent, understanding their economic implications is important.

Securities class action lawsuits can be socially beneficial if they deter wrongdoing, curb managerial rent extraction, and compensate injured shareholders. However, class actions have a well-known dark side which stands against these benefits: lawyers can have an incentive to bring low-quality (also referred to as "meritless", or "frivolous" in the literature) suits in the hope of securing a large settlement despite no actual managerial wrongdoing (e.g., Bebchuk (1988), Romano (1991), Bondi (2010)). Faced with the prospect of entering a long and resource-intensive legal dispute, and faced with the dangers of an imperfect judicial process, many firms are willing to settle cases even though the allegations have little to no legal merit. In Section 4 we present a model built around the intuition that, from the perspective of the plaintiff and the plaintiff's lawyers, filing a meritless lawsuit is a long-shot bet on imperfections of the judicial system. Cases without legal merit are almost surely socially wasteful: they do not sanction any wrongdoing, they hurt corporate shareholders, they may distract managers from running their companies, and they are a burden on the judicial system.

While, all else equal, minimizing the amount of meritless class action litigation appears desirable, designing optimal policy to discourage meritless suits is difficult. A case in point is the Private Securities Litigation Reform Act of 1995, which did not prevent a large number of low-quality class actions being filed after its passage. A more recent illustration is the Lawsuit Abuse Reduction Act (LARA), which aims at curbing meritless litigation by holding plaintiff lawyers accountable for the cases they bring.[7]

LARA is controversial. Critics argue, for example, that introducing fines for lawyers, as

[7] At the time of writing, this reform has passed the U.S. House of Representatives, and has moved on to the Senate Judiciary Committee.

proposed in LARA, would be an obstacle to filing meritorious claims, and create a new problem of costly follow-on litigation (see, e.g., Kaufman (2017)). A remarkable, and perhaps surprising, fact about the discussion surrounding LARA, which echoes a similar state of affairs surrounding the introduction of PSLRA, is that there seems to be substantial disagreement on a central object: just how costly are meritless class action lawsuits? For example, on one end of the spectrum, the U.S. Chamber of Commerce argues that: "*Every year, potentially billions of dollars are wasted on frivolous lawsuits, hurting job growth and slowing the economy*" (U.S. Chamber of Commerce (2017)). On the other end of the spectrum, the American Bar Association argues that the costs associated with meritless litigation are, at best, small, and that claims of high costs are mostly based on anecdotes rather than large-scale empirical research (American Bar Association (2017)).

The divergence of opinion on such a central issue underscores the need for systematic empirical evidence on the cost of meritless litigation, and, importantly, the channels which induce these costs. Our paper provides new empirical evidence on these questions based on a comprehensive large-scale dataset on class action lawsuits in the U.S.

4 Theoretical Framework

To fix ideas, this section presents a simple model. The model is highly stylized, but we nevertheless believe it captures central features relevant to understanding the potential relationship between corporate innovation output and class action lawsuits. The first main goal is to provide intuition as to why higher innovation output may lead to more low-quality litigation. The second main goal is to derive testable predictions, which we will test in the following sections.

Suppose that there are K firms and K law firms. At the beginning of each period, each law firm is randomly matched with a firm so we get K law firm-firm pairs.

The sequence of events is as follows. In $t = 0$, a law firm can costlessly do a pre-scan on the firm for opportunities to bring a suit. If a law firm decides to file a suit, it has to incur a cost $0 < c < 1$. In $t = 1$, after a suit is filed, the defendant files a motion to dismiss. A judge then decides on whether or not to dismiss the case. If the case is not dismissed, the case is either settled, or else goes to trial. If there is no settlement and the case goes to trial, the court issues a verdict in $t = 2$.[8] If a defendant loses the trial, it has to pay a fine of $J = 1$. Periods are independent, discount rates are zero, and all firms and law firms are risk-neutral.

The K firms are indexed by $k = 1, \ldots, K$. Type k refers to case quality, and a higher k indicates a higher quality case. We define a high-quality case to be one which has a high chance

[8]The purpose of the "trial" in the model is to capture any remaining uncertainty about the case outcome after the motion to dismiss in a parsimonious manner. Empirically, securities class action cases are almost never resolved through a trial. In practice, uncertainty about the case outcome after the motion to dismiss is reflected in the judge's decision on class certification and on the motion for summary judgment, for example.

of not being dismissed by a judge upon the motion to dismiss.[9] We denote the probability of dismissal by $p_d(k)$. We consider three classes of cases:

- For $k < \underline{k}$, we assume a probability of dismissal of $p_d = 1$. Intuitively, this set captures firm-law firm pairs for which there is no feasible legal strategy for the law firm to build a case without it being obviously frivolous. We model this by assuming that such cases would always be dismissed, which implies in the presence of filing cost $c > 0$ that law firms would never file such a suit. For brevity and conciseness, we refer to these lowest quality cases as "non-cases" in the following.

- For $k > \overline{k} > \underline{k}$, we assume a probability of dismissal of $p_d = 0$. We think of these as cases of actual wrongdoing and clearcut violations of securities laws (e.g., Enron). This subset of cases is never dismissed and, as we explain below, will always be brought under our assumptions. For brevity and conciseness, we refer to these highest quality cases as "meritorious cases."

- For $\underline{k} < k < \overline{k}$, we assume an ordering $0 < p_d(k) < 1$, where $p_d(k)$ strictly decreases in k (i.e., $p_d(k) - p_d(k-1) < 0$). These cases thus vary in quality, and higher quality cases are associated with a higher chance of not being dismissed. To make our point in the most parsimonious manner, we assume that firms in this group have not actually violated the law. Assuming $p_d(k) < 1$ thus captures the idea that lawyers may file meritless cases if the circumstances are sufficiently opaque and if the judicial process is less than fully perfect in its ability to detect meritless allegations (in line withe the standard assumptions in the law literature, e.g., Romano (1991), Bondi (2010)). For brevity and conciseness, we refer to these intermediate-quality cases as "fundamentally meritless cases."

By design of our model, non-cases never survive the motion to dismiss. For fundamentally meritless cases we assume that, if a case survives the motion to dismiss, and if it is not settled, there is a positive probability that the defendant loses in a trial. This may be due to a judicial mistake or because additional material facts emerge in the discovery phase. To save on notation, and without loss of generality, we assume the conditional probability of the defendant winning the trial is the same probability as the probability of dismissal upon the motion to dismiss, $p_d(k)$. Completely analogously, for meritorious cases we assume the conditional probability of the defendant winning the trial is $p_d = 0$ (this is clearly a simplification, but should not affect any of our main conclusions under reasonable extensions).

[9]It is also possible to specify the model such that case quality is defined as an increasing function of the payoff for the plaintiff upon winning the case. All predictions go through in that case under the assumption that the dismissal probability decreases in case quality.

From the law firm's perspective, the decision to file a suit depends on the expected payoff from a case relative to the cost of bringing the suit. Given our assumptions, the expected payoff is $(1-p_d(k))^2$ and the cost is c. This implies that non-cases are never brought, since $0 < c$, and that meritorious cases are always brought, since $(1-0)^2 > c$. Fundamentally meritless cases are filed if $(1-p_d(k))^2 > c$. The central intution captured by the model is thus that lawyers have a rational incentive to file some meritless suits because they are positive expected value bets.

Two comments are in order. First, so far, there is no reason for the firm to settle, as opposed to waiting for the trial outcome. This is not critical for the argument we make here. An incentive to settle could easily be introduced by assuming entering the trial phase is costly to the defendant. We will introduce such an incentive to settle below. Second, we could extend the model by assuming that the firm incurs a loss in its market capitalization upon the filing of a lawsuit. This would be consistent with the empirical results we present below. However, since these costs are "sunk" once the case is filed, they will not matter for what follows, and so we abstract from them here.

We now present two channels that generate testable predictions on how innovation output links to class action lawsuits.

Channel 1 (higher innovation output lowers filing costs for the plaintiff): Sucessful innovation may make it easier for a law firm to attack, in the sense that valuable innovation output is associated with a lower cost of bringing a suit. Specifically, we provide direct evidence in Internet Appendix Section IA.A that firms with valuable innovation output issue more forward-looking statements. Such statements are by nature more speculative, thus providing an opening for lawyers to craft a meritless suit upon seeing a stock drop (Rogers, Buskirk, and Zechman (2011)). If the law firm needs to spend less effort and resources in setting up the legal strategy, or if the concern about potential negative repercussions on the law firm's reputation is weaker when the facts of the case are more opaque, then the lawyer's cost c associated with suing high innovation firms is lower.

We derive the following main prediction in Appendix A.2:

Main Prediction: *Across all K firms, the chance of being subject to a lawsuit that is dismissed increases as innovation output increases.*

The intuition is simple: when the marginal benefits curve from suing is unchanged, then lowering the marginal cost of suing leads to more lawsuits in general, and more low-quality lawsuits in particular.

In the appendix, we also derive the following three auxiliary predictions:

Prediction 1: *Across all K firms, increasing innovation output makes it more likely that a lawsuit is filed.*

Prediction 2: *Across all K firms, the chance of being subject to a lawsuit that is not* *dismissed increases as innovation output increases.*

Prediction 3: *Across all K firms, as innovation output increases, the chance of being subject to a lawsuit that is dismissed increases more than the chance of being subject to a lawsuit that is not dismissed.*

Channel 2 (higher innovation output increases litigation costs for the defendant): Suppose, as we will show empirically to be the case later, that going to trial is costly to a firm, over and above the expected payoff to the plaintiff in case of a lost trial. Such additional costs may come in the form of reputation costs or other opportunity costs, which likely accumulate as the case is pending. Examples of such costs would be losses due to worse terms of trade and financing, lost business, or employee turnover. To incorporate this in the simplest manner, we assume that these costs are normalized to zero in the baseline case, and that there are incremental costs of $C_I > 0$ if innovation output is high. This formulation captures that opportunity cost and reputation concerns are more likely of a concern for successful innovators, which is directly motivated by the findings of KPSS, who show that firms with valuable innovation output grow more, in terms of sales, employees, and investment, than other firms. We show in Internet Appendix IA.A that the results from KPSS also obtain for our sample. We thus hypothesize that (i) managers who are busy growing their firms have high opportunity costs on their time and resources, and that (ii) firms which have just been issued a valuable patent, and are about to bring a new product to the market, are particularly sensitive to bad publicity.

Conditional on a non-dismissed case, an innovative firm thus stands to lose $1 - p_d + C_I$ if it does not settle and goes on to trial. Without settlement, and conditional on having filed a non-dismissed case, the expected payoff to the law firm is $1 - p_d$. Hence, both the firm and the law firm would find it profitable to settle after the judge has ruled on the motion to dismiss. Specifically, for any $0 < \gamma < 1$, both the firm and the law firm would be better off with a settlement amount of $1 - p_d + \gamma C_I$, where γ depends on the relative bargaining power.

This extended model implies that, as of time $t = 0$, the law firm will file a suit if

$$(1 - p_d(k))(1 - p_d(k) + \gamma C_I) > c. \tag{1}$$

It turns out that, despite this altered profitability condition, all four predictions from Channel 1 go through essentially unaltered. While Appendix A.2 provides details, the intuition is again straightforward: increased litigation costs for the defendant imply larger benefits from suing for the law firm. With costs for law firms unchanged, an increase in the benefit of suing leads to more lawsuits in general, and more low-quality lawsuits in particular.

In the following sections we investigate whether the predictions derived in the simple model above are consistent with the data.

5 Data

5.1 Class Action Lawsuits

The core of our data are securities class action lawsuit filings obtained from the Stanford Securities Class Action Clearinghouse (SCAC) database. The SCAC covers essentially all securities class action lawsuits filed in a federal court in the United States since the adoption of the Private Securities Litigation Reform Act (PSLRA), starting in 1996. The database provides filing dates for each lawsuit as well as all associated court filings. We exclude cases related to IPO underwriter allocation, analyst coverage, and mutual funds, because we want to eliminate cases where agents and not the firm itself allegedly engaged in wrongdoing.

For most of our tests, we are interested in separating cases into those that are more likely based on actual wrongdoing, and those that are more likely frivolous. While that split is conceptually clear, empirically identifying lawsuit merit is difficult. Because actual wrongdoing is mostly unobservable to the econometrician (extreme cases of corporate fraud aside), it is necessary to find suitable proxies for lawsuit merit. The baseline proxy we use in this paper is whether the case is dismissed, which is information provided by the SCAC. Effectively, this definition assumes that a case is more likely of low quality if a judge decides to grant a motion to dismiss, or if the plaintiff decides to drop the case voluntarily.[10] Our approach is similar to the one adopted in the literature on corporate fraud, which also uses dismissals to proxy for lawsuit merit (see, e.g., Dyck, Morse, and Zingales (2010), Wang and Winton (2014), and our discussion in the robustness section below).

We believe that case dismissal, as defined by the SCAC, is a suitable proxy for relative lawsuit merit, because it exploits the fact that judges are legal experts who spend considerable time and effort on each case, scrutinizing and interpreting a rich set of information that is hard to evaluate, if not outright unobservable, to researchers. Hence, if a judge decides a case is not strong enough to survive a motion to dismiss, we conclude that the case has an elevated likelihood of having little or no legal merit. We draw the same conclusion if a case is dismissed because the plaintiff voluntarily decides to drop the complaint.[11] The implicit use of expert judgment and non-public case-relevant information are advantages of using dismissal as a measure of case quality.

The summary statistics in Table 1 show that our observations are split roughly equally between dismissed and non-dismissed cases. Using dismissals as a proxy for lawsuit quality, Figure 1 suggests that low-quality litigation may be an increasingly important problem. In 2011 (the

[10]The SCAC distinguishes only between dismissed cases and settled cases. Even though not provided by the SCAC, dismissals could be further grouped into cases that are dismissed with and without prejudice following a motion to dismiss. We have not pursued such finer breakdowns of dismissals, because any grouping will be subject to the fundamental problem that both type 1 and type 2 errors are inevitable.

[11]Less than 10% of the dismissals in our sample are due to voluntary dismissal. In Table 5, Panel B, we show that our results are robust to excluding voluntary dismissals.

last year with reasonably complete data on case outcomes in our sample), more than 65% of all cases are subsequently dismissed, which represents a substantial increase over the 35% dismissed cases filed in 1996.

A drawback of the dismissal proxy is measurement error. Inevitably, because the judicial process is not perfect, there will be some lawsuits that we mistakenly define as meritless even though they are meritorious, and others that we classify as meritorious even though they are meritless. For example, it is possible to think of cases in which the court uses a motion to dismiss to clarify how a law should be interpreted in a good faith dispute, or where the plaintiff decides to drop the complaint voluntarily for reasons unrelated to lawsuit merit. While it is impossible to separate meritless from meritorious cases without error, we view it as indisputable that the average merit, and therefore also the average case quality, is lower among dismissed lawsuits than among non-dismissed lawsuits. It is this feature of our baseline definition that we exploit in our empirical tests. Note that classical measurement error in our proxy for lawsuit quality (i.e., our dependent variable) would reduce the precision of our estimates and therefore work against us. To make sure our main results are not driven by one specific proxy for lawsuit quality, and to be conservative, we consider a range of alternative proxies below and show that our main results obtain also for these alternative measures.

5.2 Innovation Output

Following the existing economic literature on innovation, we measure innovation output based on patents granted to the firm. For our baseline definition, we obtain the annual firm-level innovation output measure developed in Kogan, Papanikolaou, Seru, and Stoffman (2017) (KPSS) from Professor Noah Stoffman's website. The measure provides an estimate of the private value of the patents granted to a firm by the United States Patent and Trademark Office (USPTO) in a given calendar year, by exploiting movements in stock prices in the three days following the patent grant announcement. As the measure is in dollars, we follow KPSS and scale it by lagged book assets. We call the resulting measure "innovation value."

The KPSS measure of valuable innovation output is ideal for our purpose for a number of reasons. First, the valuable innovation hypothesis posits that successful innovators are more attractive litigation targets because they have valuable growth opportunities and may communicate those to investors. The KPSS measure is ideal to assess this hypothesis, since KPSS show (and we confirm for our dataset) that their measure is a particularly strong predictor of subsequent growth in employment, capital, output, profits, and revenue-based total factor productivity. Substantial growth in these variables provides a reasonable proxy for firms' opportunity costs, since growing firms want to focus resources on growth and not get side-tracked by non-growth related disturbances. Firms with growth opportunities can also be expected to communicate with investors in a positive and forward-looking way in order to raise capital. Second, the KPSS measure of innovation output is based on patent grants, not filings of patent applications. Because the filing date for a patent precedes the patent grant date by, on average, 2.9 years, we can plausibly view the existence of a technological innovation in year t as predetermined, which helps our identification. Third, the measure is constructed assuming that the market forms an expectation about the economic value of an innovation before the patent grant date and that no new information is released by the grant decision itself. KPSS argue this is a reasonable assumption and present supporting evidence. This feature is very useful in our setting, because it mitigates the possibility that new information drives both, the measured return to an innovation, and the propensity to be subject to a lawsuit.[12]

While the KPSS measure has a number of attractive features, some limitations should be noted. First, it is a measure of the *expected* economic value of a patent at the time where the patent is granted by the USPTO; it approximates, but is not the same as, the *actual* economic value of the patent. Second, it may estimate the expected economic value of the patent with some error. In particular, KPSS assume that the probability the market assigns to the likelihood of a patent being granted is uncorrelated with the patent's economic value. Violation of this assumption may give rise to measurement error in the estimated patent value. As KPSS note, aggregating patent values within a firm-year, as we do in this paper, will partly alleviate this concern. We discuss and address measurement error concerns in more detail in Sections 6.7 and 6.5. The former estimates instrumental variable regressions. The latter shows that our main results also obtain if we use alternative measures of innovation output, such as raw patent counts and citation-weighted patent counts, which are not subject to the above criticism.

5.3 Sample

The innovation value measure is available until 2010, which means that our combined litigation-innovation dataset spans the period from 1995 to 2011, with innovation measures from 1995 to 2010 and class action lawsuit filings from 1996 to 2011. A class action lawsuit in our sample is resolved (i.e., dismissed or settled) on average after 771 days for dismissed cases and 1,403 days for settled cases. Since our sample ends in 2011, we have an essentially complete sample of all filed class action lawsuits, including their resolution, throughout our sample period. Following KPSS, we replace innovation value with zero if a firm is not granted any patent in a given year. We omit firms in industries that never patent in our sample, as well as financial firms (SIC codes 6000 to 6799) and utilities (SIC codes 4900 to 4949). We match our innovation-litigation data with

[12]Patent application filings were not officially publicized by the USPTO prior to the year 2000. However, according to KPSS, firms frequently announced patent applications themselves and, as a result, the market usually had information about the patents prior to the grant date. We show in Table 5 that our main results are robust to restricting our sample to the post-2000 period.

financial information from Compustat, stock return information from CRSP, and institutional holdings data from Thomson Reuters 13-F filings.

Our final sample consists of 40,010 firm-year observations by 6,101 unique firms with non-missing data for our key control variables. Table 1 reports descriptive statistics. Unconditionally, there is a 1.0% chance that a low-quality class action lawsuit is filed against a firm in our sample. Innovation value, i.e., the total economic value of patents granted to a firm scaled by lagged assets, has a mean of 2.4% and a standard deviation of 6.0%, which implies there is substantial variation in the value of innovative output across the firms in our sample.

6 The Effect of Valuable Innovation Output On Shareholder Class Action Lawsuits

This section presents evidence that valuable innovation output increases the likelihood of being the target of a low-quality class action lawsuit. We also present estimates of the costs to shareholders in the targeted firm around the filing of a class action lawsuit.

6.1 Sorting

We begin with a simple sorting exercise. The lower graph in Figure 1 presents the annual probability of a low-quality class action lawsuit filed against two groups of firms over our sample period. Low innovation output firms are firms with a zero KPSS measure, i.e., firms without any patent grant, in the previous year. High innovation output firms are those in the top tercile formed according to the KPSS measure of valuable innovation output among the remaining firms in the same industry-year. Industries are defined using 2-digit SIC-industry codes. Low-quality lawsuits are defined using the SCAC dismissal classifier as discussed in Section 5.

The results shown in Figure 1 are striking. In every year during our sample period, the probability of being subject to a low-quality lawsuit filing is substantially larger for firms with valuable innovation output than for firms without valuable innovation output in the same industry and year. On average, the probability of being targeted with a low-quality lawsuit is more than three times as large for successful innovators.

6.2 Regressions

We next examine whether the pattern observed in Figure 1 holds up in a multivariate setting. Our baseline regression specification is:

$$y_{ij,t+1} = \lambda_{jt} + \beta \mathcal{I}_{it} + \gamma X_{i,t-1} + \epsilon_{ij,t+1}, \tag{2}$$

where $y_{ij,t+1}$ is an indicator variable equal to one if a class action lawsuit is filed in year $t+1$ against firm i in industry j, $\mathcal{I}_{it}$ refers to the KPSS measure of valuable innovation output, and λ_{jt} are 2-digit SIC-industry $\times$ year fixed effects. We include industry-year fixed effects because we want to rule out that the link between valuable innovation and subsequent litigation is driven by industry-specific business cycles, where more innovation in booms is followed by more litigation in busts for reasons that are unrelated to innovation.[13] $X_{i,t-1}$ is a vector of lagged control variables. Our set of baseline controls follows Kim and Skinner (2012), who empirically investigate the main predictors of shareholder litigation. Specifically, we control for Tobin's Q,[14] the log of assets, cash holdings, sales growth, institutional ownership, stock returns, volatility, skewness, and turnover. All variables are defined in Appendix A.1 and the full list of coefficients is reported in Internet Appendix Section IA.B. We use a linear probability model to estimate Equation (2) and cluster standard errors at the firm level.

Table 2, Panel A, presents our main results for three different dependent variables: an indicator for all lawsuits filed in $t+1$; an indicator for the subset of low-quality lawsuits as defined in Section 5; and an indicator for the remaining subset of high-quality lawsuits. Columns (1) to (3) present results using only accounting and ownership-related control variables, whereas columns (4) to (6) add controls related to stock returns and trading volume.

Looking at columns (1) and (4), we find a strong positive link between valuable innovation output and the filing of a class action lawsuit in the following year, consistent with Prediction 1 of the model above. From a shareholder-value standpoint this is bad news, because being subject to a class action lawsuit is costly (we provide an estimate of these costs below). From a societal standpoint, it matters whether the increase in litigation is driven by meritless or meritorious lawsuits. If most of the effect comes from meritorious lawsuits, and if more actual fraud is discovered as a result, then valuable innovation can have a positive side-effect for society which may outweigh the negative effect of shareholder losses. By contrast, more meritless litigation is bad for both, shareholders and society.

To determine the source of the overall increase in lawsuit filings, we next reestimate our regressions using indicators for low-quality lawsuits, which are more likely meritless, and high-quality lawsuits, which are more likely meritorious, respectively. We find that the effect is almost exclusively driven by an increase in the filings of low-quality lawsuits against successful innovators. In the full model, reported in columns (5) and (6), the coefficient on the innovation value variable is highly statistically significant for low-quality litigation ($t = 3.50$), but not statistically different from zero for high-quality cases ($t = 0.73$). The point estimate in column

[13] Lerner and Seru (2017) document substantial variation in patenting activity, and Kim and Skinner (2012) document variation in litigation rates, both across industries and over time.

[14] We find very similar results if we use the measure of Tobin's Q by Peters and Taylor (2017), which includes intangible capital.

(5) implies that a one standard-deviation shift in innovation value increases the probability of a low-quality class action lawsuit filing in year $t + 1$ by 0.34 ($= 0.057 \times 0.060$) percentage points, which is sizable relative to the unconditional probability of a low-quality lawsuit filing of 1.0%.[15]

All patterns are consistent with the main prediction and auxiliary Predictions 1 to 3 of the model in Section 4. Note that, while our second auxiliary prediction is an increase in high-quality cases, the size of that increase is a function of the average dismissal probability among the incremental cases, i.e., the cases that are only brought if innovation is high. The higher that probability, the more will an increase in innovation affect only low-quality and not high-quality lawsuits. As that probability approaches one, our model predicts the increase in high-quality cases to approach zero. We can use the coefficients in Table 2, columns (5) and (6) to back out that probability (see Equation (15) in Appendix A.2 for details). The coefficients imply that incremental cases are of very low quality, with an average dismissal probability of 83%. Hence, while high-quality cases go up, consistent with the model, the magnitude of this increase is so small that we cannot statistically distinguish it from zero.

The results in Table 2, Panel A, are important because they suggest the existence of an implicit "tax" on valuable innovation output, brought about by an increased probability of being subject to low-quality shareholder class action litigation. The controls we include show that our results are not due to innovation output being correlated with general differences in firm size or value and growth attributes as captured by lagged Tobin's Q, sales growth, cash holdings, trading-volume, and properties of the firm's stock return distribution.[16]

To get a better sense of the functional form that relates valuable innovation output to shareholder litigation, Figure 2 presents nonparametric binned scatter plots. We compute averages of low-quality class action filing probabilities for 50 innovation value bins, obtained after first residualizing both the class action filing and innovation variables on industry $\times$ year dummies and the same set of controls as in Table 2, column (5). Figure 2 shows that the probability of being target of a low-quality lawsuit increases quite steadily in innovation value. In particular, the plot suggests that the positive relation between valuable innovation and subsequent low-quality litigation is not driven by outliers. The pattern is robust to altering the number of bins (results unreported for brevity). In contrast, the relationship between valuable innovation and high-quality litigation is much flatter.

[15]The difference in the relative increases implied by the coefficients in columns (5) and (6) is statistically significant at the 5% level. The same applies to the relative increases implied by the coefficients in columns (2) and (3).

[16]The results in Table 2 show that valuable innovation does not increase *observed* meritorious litigation. An interesting but separate question is whether valuable innovation increases the propensity to engage in actual fraud. We follow a standard approach in the literature on corporate fraud and estimate bivariate probit models (e.g., Wang (2013)) to separate fraud detection from fraud commission. We do not find any evidence to suggest valuable technological innovation would increase the propensity to commit fraud. We provide further details on these results in Internet Appendix IA.F.

Finally, we also consider the dynamics of the relationship between valuable innovation output and low-quality litigation risk. To do that, we estimate regressions of the following form:

$$y_{ij,t+h} = \lambda_{jt} + \sum_{\tau=0}^{\tau=h} \beta_\tau \mathcal{I}_{i,t+\tau} + \epsilon_{ij,t+h}. \tag{3}$$

The dependent variable is an indicator equal to one if a low-quality lawsuit is filed against firm i between (and including) years t and $t+h$, and zero otherwise. The coefficient of interest is $\beta_{\tau=0}$, which measures the incremental effect of innovation in year t on the cumulative probability of a low-quality class action filing between (and including) years t and year $t+h$. The regression does not include any additional controls, because those controls would be endogenous.[17] For each h we consider, we estimate a separate regression.

Figure 3, Panel A, reports the coefficient $\beta_{\tau=0}$ after varying the horizon h of the dependent variable from one to four years (h is plotted on the x-axis of the figure). The leftmost data point, which represents the regression for $h = 0$, shows that there is an elevated probability of being subject to a low-quality lawsuit in year t for firms with valuable innovation output in that same year. The confidence bounds indicate that the effect is statistically significant at the 5% level. The data point at $h = 1$ shows that the largest effect, i.e., the largest incremental change in $\beta_{\tau=0}$ across all values of h on the x-axis, is realized in the year after a firm was granted with valuable patents. In the following years, $h = 2, 3, 4$, the incremental effect of innovation in year t is still positive, but economically much smaller. The pattern that it takes a while for innovation today to attract a lawsuit, but that, at the same time, innovation today does not matter much for lawsuits many years out, appears very plausible.

In Panel B, we also study the cumulative lawsuit probability in years prior to innovation in t, and do not find an elevated lawsuit probability for any value of h we consider.[18] The results from these tests, which can be interpreted as a placebo test, show that successful innovators are not simply firms with an elevated litigation risk for other reasons. Before firms are granted valuable patents, they are not at an increased risk of receiving a low-quality lawsuit relative to other firms.

In our view, the dynamic patterns from Panels A and B substantially increase the hurdle for potential alternative explanations. Any alternative hypothesis would need to be consistent with

[17] While we believe the above specification is the most appropriate one, we have estimated the regression with the set of controls measured in $t-1$, and we have also estimated a specification with firm fixed effects added to Equation (3). Both alternatives deliver qualitatively similar results to the specification in Equation (3).

[18] Specifically, we report coefficient $\beta_{\tau=0}$ from the following regressions, where h is varied from one to four:

$$y_{ij,t-h} = \lambda_{jt} + \sum_{\tau=-h}^{\tau=0} \beta_\tau \mathcal{I}_{i,t+\tau} + \epsilon_{ij,t-h}. \tag{4}$$

no effect before patent grants, the effect being strongest in the year after successful innovation, and the effect decreasing in future years.

In sum, we conclude from the results in this section that valuable innovation output is strongly related to subsequent low-quality shareholder litigation, and that this link is neither induced by a rich set of observable variables, nor by unobserved factors at the industry-year level, nor by stable differences between innovative and non-innovative firms.

6.3 Innovation Output versus Innovation Input

Our results so far are consistent with the predictions of the valuable innovation hypothesis, which links valuable innovation output, as captured by the KPSS measure, to subsequent class action lawsuits. A potential concern with our previous results could be that we observe a positive and significant relation between innovation output and low-quality lawsuits simply because innovation output is correlated with innovation input.

Innovation input, usually measured using R&D expenditures in existing work, captures the amount of research and development done by a firm. The risky innovation hypothesis posits that companies with large investments in R&D are more likely to experience large stock drops, and therefore low-quality lawsuits, because investments in innovation projects have an elevated failure propensity. This view is reflected, for example, in the statement of the CEO of Silicon Graphics we cite in the introduction: *"the high-tech firms of Silicon Valley and the Bay Area's bio-tech companies are the No. 1 target of these schemes [meritless class action lawsuits], because cutting-edge research and the risks inherent in development make their stock prices volatile."* The emphasis of the risky innovation hypothesis on innovation inputs and how they make stock drops more likely makes it testably different from the valuable innovation hypothesis, which emphasizes innovation output and does not argue that successful innovation increases the likelihood of a stock drop.

To empirically separate the two hypotheses, we start by running a horse race between the KPSS measure of innovation output and R&D expenditures as the standard measure of innovation input.[19] The results are presented in Table 2, Panels B and C. Panel B follows Kim and Skinner (2012) in relating this year's R&D investment to next year's probability to be litigated. Panel C replaces last year's R&D by a three-year moving average. Across all panels and specifications, we find that the coefficients on innovation output are effectively unchanged relative to our baseline, while innovation inputs are always insignificant, irrespective of whether we consider all cases, high-quality cases, or low-quality cases. We conclude that innovation output matters for litigation rates over and above innovation input. We also conclude that innovation input is unrelated to low-quality litigation.

[19] We replace missing values of R&D by zero, but we find very similar results if we do not replace missing values.

To further strengthen our point that it is not the riskiness of firms with valuable innovation output which drives their higher litigation risk, we explicitly test whether successful innovators are more likely to experience negative events, such as large stock price drops or unexpectedly poor accounting performance. In Table 3, we analyze the effect of valuable innovation output on daily stock return volatility, skewness, large negative stock returns, and large negative earnings surprises. In specification (1), we regress next-period stock return volatility on innovation value and volatility today, as well as the same controls as in Table 2, Panel A, specification (5). Stock volatility is measured as the standard deviation of daily stock returns in a given firm-year. Specification (2) repeats the same regression using next-period stock return skewness (based on daily stock returns within a firm-year) as the dependent variable. In specification (3), to capture the likelihood of experiencing an extreme negative return shock, we define an indicator equal to one if a given firm's first percentile of daily stock returns in a year is in the bottom 5% across all firms in that year. Specification (4) uses the same definition as in specification (3), but replaces the first return percentile by the firm's lowest quarterly earnings surprise in a given calendar year. Due to the high persistence in daily stock return volatility and skewness, we estimate dynamic specifications.

Across all four measures, we find no indication that valuable innovation output is associated with a statistically or economically significant increase in the likelihood of experiencing lawsuit-triggering events in the following year. If anything, valuable innovation is associated with *lower*, not higher, subsequent stock return volatility. This is consistent with patent grants reducing uncertainty about the firm's innovation output rather than exacerbating uncertainty. Note that a lawsuit filing could mechanically lead to higher volatility. Hence, the tests in Table 3 are biased towards finding an increase in volatility. The fact that we nevertheless find the opposite reinforces our conclusion that the positive link between valuable innovation output and subsequent litigation is not driven by greater uncertainty due to valuable innovation. While existing anecdotal evidence (see, for example, the CEO of Silicon Graphics we quote in the introduction), and prior academic studies (e.g., Lin, Liu, and Manso (2019)) have argued that innovation may increase litigation risk because it induces greater stock return volatility, our results in this section suggest that a different economic channel is needed to understand the link between valuable innovation output and low-quality securities class action litigation.

In sum, these results highlight that distinguishing between innovation input and innovation output is crucial for understanding how class action lawsuits relate to corporate innovation. To the best of our knowledge, this distinction is largely ignored in the related academic literature as well as in the public and political debate. In particular, our results show that for those cases which are most in the spotlight of practitioners and policy makers for their potential adverse economic effects – low-quality class action lawsuits – innovation output matters, but not innovation input.

The findings in this section argue in favor of the valuable innovation hypothesis we propose in this paper, and against the more traditional risky innovation hypothesis that is influential with lawyers, economists, lawmakers and policy-makers.

6.4 Ex-Ante Proxies for Lawsuit Quality

We believe case dismissal, as defined in the SCAC database, is a good proxy for relative lawsuit quality in our setting, because dismissed cases can plausibly be expected to be *on average* of lower-quality, and more likely lacking merit, than cases that are not dismissed. But, as discussed above, the dismissal proxy is not perfect, since the legal merits of a case are effectively unobservable to researchers. We address potential concerns with respect to the measurement of lawsuit quality in two ways.

First, we exploit the fact that the combined set of results – the results for all lawsuits, high-quality lawsuits and low-quality lawsuits – in Table 2 raises the bar for alternative explanations considerably. For example, one may hypothesize that firms with valuable innovation hire better lawyers, or that judges are predisposed to show leniency towards firms that are about to invest and hire new employees, which would predict that innovation success makes it more likely that a case is dismissed, even though, fundamentally, it is meritorious. These hypotheses are inconsistent, however, with the other results in Table 2, Panel A. Specifically, better defense lawyers and more lenient judges would not predict an increase in the overall likelihood of a lawsuit being filed. Specifications (1), (2), (4) and (5) show that these predictions are very different from what we observe in the data. In general, we find it hard to think of plausible stories which would be jointly consistent with the patterns we see for all lawsuits, low-quality lawsuits, and high-quality lawsuits, and which would dominate the valuable innovation hypothesis in terms of Occam's Razor.

Second, we present results for a range of alternative proxies for lawsuit quality, which are based on ex-ante information when the lawsuit is filed. While, inevitably, none of the alternative proxies we consider is perfect either, finding similar results across a broad range of different proxies strengthens the case for a robust link between valuable innovation output and low-quality class action lawsuits. An attractive feature of the alternative proxies we consider is that they are all based on public information at the time of the case filing, which should help attenuate any remaining concerns that our results are affected by how firms or judges respond to a lawsuit filing.

Our first alternative proxy for class action quality is an indicator for whether the defendant firm was subject to an accounting-related SEC investigation in the filing year or in the two calendar years prior to the filing. This proxy is motivated by the fact, established in prior related research, that material financial misstatements are a strong indicator of lawsuit merit (e.g., Choi, Pritchard, and Fisch (2005), Karpoff, Koester, Lee, and Martin (2017)). We obtain information on SEC enforcement actions from the Accounting and Auditing Enforcement Releases (AAER) database. We then rerun the baseline results from Table 2, using the SEC-based alternative proxy.

Table 4, Panel A, presents results. We find that using SEC enforcement actions as an alternative proxy for lawsuit quality yields qualitatively identical results to our baseline definition which uses dismissed cases. Specification (2) shows that there is no significant relation between valuable innovation and lawsuit filings for cases in which the SEC has a concurrent enforcement action, i.e., cases that are more likely meritorious given that the SEC tends to investigate only potentially serious cases of financial misconduct. By contrast, the remaining cases, which are more likely meritless, exhibit a strong, positive, link between valuable innovation and class action filings, as shown in specification (1).

The second alternative proxy we consider is whether the plaintiff alleges a U.S. GAAP violation in the lawsuit filing. The underlying idea is that accounting violations are more tangible than other allegations, such as misleading statements or omissions of material facts in company disclosures. Intuitively, a lawyer who wants to fabricate an allegation despite no wrongdoing would be unlikely to allege an accounting mistake where none is present, because the existence of an accounting mistake is comparatively easy to establish. As for SEC enforcement actions, an alleged GAAP violation is an imperfect, but informative, signal for case quality. We obtain data on whether a U.S. GAAP violation is alleged from the SCAC database. Specifications (3) and (4) in Table 4, Panel A, show that we obtain results very similar to our baseline when we use alleged U.S. GAAP violations to proxy for case quality.

Our third approach is to use a predictive model for lawsuit quality. To that end, we combine a large set of variables available at the time of the lawsuit filing to obtain an ex-ante predicted probability of case dismissal. We estimate a linear probability model where lawsuit dismissal is predicted using information about the violations of the Securities Act of 1933 and the Securities Exchange Act of 1934 alleged in the complaint (we distinguish 8 categories), the nature of the allegations in the complaint (we distinguish 7 categories), variables capturing specific trends in the types of class action suits filed (we distinguish 3 categories), losses around the corrective disclosure event, alleged fraud duration, filing gap, characteristics of the plaintiff and plaintiff lawyer, and the district where the lawsuit is filed. For brevity, we provide the results of this estimation in Internet Appendix IA.C. Based on this model, we classify lawsuits with a predicted dismissal probability above the median in a given filing year as low-quality, and as high-quality otherwise. Specifications (5) and (6) in Table 4, Panel A, present results which again show that valuable innovation is strongly linked to class action filings if the case has a high probability of dismissal, but not otherwise.

Overall, the results in Table 4, Panel A, are consistent across the three alternative proxies for lawsuit quality, and in line with our baseline results in Table 2: valuable innovation output leads to more low-quality securities class action litigation. Panels B and C show that a second important feature of the valuable innovation hypothesis is also preserved for the alternative proxies of lawsuit quality: it is innovation output that matters for low-quality litigation, not innovation input.

6.5 Alternative Measures of Innovation Output

As discussed in Section 5, we use the KPSS measure as our baseline measure of innovation output because the valuable innovation hypothesis posits that successful innovators are more attractive litigation targets due to their valuable growth opportunities. Since KPSS show that their measure is a particularly strong predictor of subsequent growth in employment, capital, output, profits, and revenue-based total factor productivity, it provides an ideal measure for our tests. For completeness, this section explores the relationship between other measures of innovation output and subsequent litigation risk. We report these results in Table 5, Panel A. We report the same specification as in Table 2, Panel A, specification (5), and omit coefficients on control variables for brevity.

We first use the total number of patents granted to the firm. Next, we use citation-weighted patent counts, obtained from Professor Noah Stoffman's website. We also define an indicator equal to one for patents which rank in the top decile of citations among all patents granted in the same technology class and year (we obtain the necessary data from the Patent Examination Research Dataset ("PatEx")). Overall, we obtain qualitatively similar results using these alternative measures of innovation output, although the economic magnitude is lower than for the KPSS measure of innovation output.

These findings are informative about the drivers of our baseline results. The key difference between the KPSS measure and the first three measures of innovation output in Table 5, Panel A, is the KPSS measure's emphasis on the private economic value of a firm's patents. Economic value is plausibly related to, but distinctly different from, the raw number of patents or the scientific value of these patents.[20] If the valuable innovation hypothesis describes the data well, we expect to see stronger results when we use a measure which focuses on the value of innovation output. In that sense, the results in this section provide support for the valuable innovation hypothesis.

Since firms may produce economically valuable innovation output even if they do not patent those innovations, we also use, in a final test, the market value of new product introductions as

[20]See, e.g., Abrams, Akcigit, and Grennan (2019), who show that the relation between scientific and economic value of patents, while overall positively correlated, follows an inverted U-shape pattern.

defined by Mukherjee, Singh, and Žaldokas (2017). Their innovation measure, which we obtain from Professor Alminas Žaldokas' website, is constructed from abnormal stock returns around press releases on new product announcements. Using their measure, we find a positive relationship between economically valuable new products and subsequent litigation risk, consistent with the idea that firms with valuable new products also have valuable growth opportunities. However, the statistical significance is weaker than in our baseline tests. A potential explanation for the lower statistical significance is that the date of a product announcement is endogenously chosen by the firm, and may therefore systematically coincide with other firm-specific news, which might bias the coefficient downwards. Since the patent grant date is chosen by the USPTO, and not by the firm, the KPSS measure of innovation output is less likely to be contaminated by other firm news and may therefore contain less measurement error. This highlights a particular advantage of the KPSS measure in our context.

6.6 Additional Robustness Tests

Next, we perform a series of robustness tests. In Panel B of Table 5, we show that our results are robust to defining low-quality lawsuits as lawsuits that are either dismissed or settled for less than $3 million (e.g., Dyck, Morse, and Zingales (2010)), as well as to excluding voluntary dismissals.[21] Our results are also robust to focusing on a more homogeneous set of cases: all complaints with Section 10(b) or Section 11 claims, which represent the majority of securities class actions.

Panel C considers additional controls. First, we include contemporaneous controls for sales growth, stock return, volatility, skewness, and turnover. These variables are not included in our baseline because they are likely endogenous controls: returns, volatility, and skewness may be higher because of valuable innovation. While excluding these variables is econometrically warranted, the results in Panel C show that our main results obtain also when we include them. Second, we address the possibility that the link between valuable innovation and litigation is induced by valuable innovation being a proxy for managerial overconfidence. To that end, we control for a stock-option based proxy for managerial overconfidence proposed by Malmendier and Tate (2005) and find virtually unchanged results. Third, we use firm fixed effects to attenuate concerns about unobserved firm-level heterogeneity. For example, better-run firms may be both, more likely to generate valuable innovations, and less likely to be sued for securities fraud. Including firm fixed effects leaves the point estimate and the economic significance of our effect

[21] Note that the focus of papers like Dyck, Morse, and Zingales (2010), or Wang and Winton (2014), is different from ours. Their goal is to use a conservative measure of true fraud, which is why they exclude cases with low settlements in their definition of meritorious cases. Our goal, by contrast, is to use a conservative measure of low-quality lawsuits, which is why we exclude low settlement amounts in our baseline definition of low-quality cases. We thank Cornerstone Research for providing us with data on settlement amounts.

virtually unchanged, which suggests our results are not due to omitted time-invariant firm-level factors. While the point estimate remains the same, our estimates become somewhat noisier. A plausible explanation is that, by including firm fixed effects and thus focusing on within-firm variation, identification comes mainly from firms that have at least one meritless lawsuit during our sample period. These firms represent less than 10% of the sample. Finally, by including district court $\times$ year fixed effects, we ensure that our results are not driven by innovative firms being located in districts with more business-friendly courts.

In Panel D, we examine alternative sample restrictions. First, in order to ensure our results are not driven by unobserved differences between patenting and non-patenting firms, we estimate our regressions using only firm-years with non-zero innovation. Second, in order to rule out that the technology bubble around the year 2000 drives our result, we exclude the years 2000 and 2001 from our estimation. In both cases, we find essentially unchanged results and the economic magnitude of the effect is, if anything, higher than in our baseline. Since patent application filings were not officially publicized prior to 2000, we further split the same into pre- and post-2000. We find similar effects in both subperiods. This result is consistent with the idea that, although patent filings were not officially publicized prior to 2000, investors had advance knowledge of these applications because firms often publicized patent applications themselves (see also KPSS).

6.7 Instrumental Variable Regression

Our main regressions and robustness tests above control for a rich set of observable and unobservable variables which, in our view, substantially raise the bar for alternative explanations. A potential remaining concern is that unobserved *time-variant* factors at the firm level, which are (i) not captured by our control variables and (ii) correlated with both the value of innovation output and subsequent low-quality litigation, may explain our results. While not impossible, we feel it is nontrivial to think of plausible stories along these lines, since any confounding variation would need to match the dynamic pattern we observed in Figure 3, i.e., the strong increase in litigation risk in the year following the innovation. Moreover, any alternative story needs to explain why innovation output links with low-quality lawsuits much more than it does with high-quality lawsuits.

A related concern could be measurement error in the KPSS innovation measure. To derive the economic value of a patent, KPSS use the observed share price appreciation when the patent is granted as a main input. One specific alternative hypothesis related to measurement error is that those patents with the highest observed announcement returns, and therefore the highest KPSS measures of innovation value, are those for which managers are most successful in making investors believe, potentially falsely, that the patent is very valuable. This could explain why those firms with the highest KPSS measures are subsequently facing more lawsuits. However, it does not necessarily explain why low-quality lawsuits increase more with innovation than high-quality lawsuits. To get this prediction, one would have to assume that managers are successfully inducing excessive optimism among investors, but not using truly fraudulent means, and that more managerial effort to raise false expectations increases the likelihood that some disappointed investor files a low-quality lawsuit later.[22] We feel this alternative story is sufficiently complicated to raise some skepticism. At the same time, it is still perfectly consistent with our main hypothesis: it is innovation output, not innovation input, that drives low-quality litigation. What would change is the interpretation of this empirical fact. Under the alternative story, low-quality litigation is driven by "erroneously perceived-to-be valuable innovation," rather than "fundamentally valuable innovation," but the fact remains that, in both cases, there is an elevated risk that firms that have not violated the law are targeted by class action lawsuits.

To alleviate remaining concerns about omitted variables and measurement error, we consider two instruments for innovation value. We provide a condensed discussion here, for brevity, and relegate details to Internet Appendix IA.D. The first instrument for valuable innovation we use is tax-induced changes in the user cost of R&D capital, a strategy motivated by previous studies in the literature (e.g., KPSS, Matray and Hombert (2018), Bloom, Schankerman, and Van Reenen (2013)). The underlying idea is that R&D tax credits motivate investment in R&D, and that more investment in R&D will tend to increase the total value of innovation output in the following years. The instrument exploits the fact that different firms within the same industry and year face different changes in state-level R&D tax credits depending on the geographical distribution of their R&D activity. State-level tax credits can be considerably more generous than federal tax credits and are therefore a relevant concern for firms when deciding about R&D investments.

The second instrument we use follows Sampat and Williams (2019) and exploits the leniency of the USPTO patent examiner assigned to outstanding patent applications. New patent applications at the USPTO are categorized based on the type of technology, and directed to a specialized group of examiners called art unit. Within an art unit, a supervisor then allocates new patent applications to examiners in a process that is quasi-random (Lemley and Sampat (2012)). Variation in patent examiner leniency therefore induces exogenous variation in the total value of innovation output for a given firm.

As reported in Internet Appendix IA.D, the first-stage estimates reveal a strong positive relation between R&D tax credits and subsequent innovation output, as well as a strong, positive, relationship between patent examiner leniency and innovation output. The coefficient estimates in the second-stage regression are larger but qualitatively similar to our baseline results, for both

[22]This hypothesis may sound more straightforward than it actually is. In particular, one needs to also assume that managers do not raise the market's expectation of the likelihood of patent application success prior to the patent grant. If that probability were to go up at the same time, which is quite plausible if managers try to make investors bullish about the innovation to begin with, the overall effect on *observed* share price appreciation around the grant date would be ambiguous.

instruments. These results further attenuate concerns about measurement error and omitted variables.

6.8 Quantifying the Costs of Shareholder Litigation

Valuable innovation output leads to more low-quality class action lawsuits. But how costly is low-quality litigation against successful innovators? The purpose of this section is to get a sense of the economic magnitude of the costs of low-quality shareholder litigation against innovative firms. We focus on the cost conditional on being sued (the "ex-post" effect) here, and analyze potential ex-ante implications in later sections.

6.8.1 Shareholder Losses Around Filing Dates

We start with an event study around the filings of low-quality and high-quality class action lawsuits without conditioning on innovation output. We use an event window from three trading days before the filing date to up to ten trading days after the filing, and compute abnormal returns relative to a Fama and French (1993) and Carhart (1997) four-factor model estimated over days $t = -300$ to $t = -50$. To be conservative, we only study filing events where the first trading day after the end of the class action period does not fall inside the event window (-3,+10). This ensures that the large stock drops, which usually mark the end of a class period and which are often driven by negative information the market receives about a firm, are not affecting our estimates. This, in turn, should give us a cleaner estimate of the impact of the lawsuit itself. In case of multiple lawsuits filed against the same company which later get consolidated, we only retain the filing of the first lawsuit.

The top panel in Figure 4 presents results separately for low-quality and high-quality cases, respectively. The filing of a low-quality class action lawsuit is associated with a significant drop of about 2.1% in market value for the targeted firm in the (-3,+3) window around the filing date, with no further change afterwards. Turning to high-quality lawsuits, we find, as expected, even bigger effects. Over the seven days around the filing, the market value of affected stocks drop by 3.6%, with cumulative losses approaching 5.0% by day ten. While samples and methodologies differ, the magnitude of these drops is in the same ballpark as those reported in earlier studies on stock market reactions in response to class action filings. In particular, finding substantial shareholder value losses around low-quality lawsuit filings is consistent with work by the U.S. Chamber Institute for Legal Reform (2017), Klock (2016), Griffin, Grundfest, and Perino (2004), and Pritchard and Ferris (2001).[23]

[23] Our approach above may underestimate the difference between low-quality and high-quality cases if anticipation effects are greater for truly fraudulent behavior. Consistent with the latter possibility, we find, in unreported results, much larger declines in market value around the class action period end date for high-quality than for

There are reasons to believe the above effects understate the true cost of low-quality class action lawsuits to shareholders. In particular, Gande and Lewis (2009) argue and show that lawsuits are partially anticipated by the market and that focusing on filing dates thus understates the magnitude of shareholder losses. In addition, Karpoff, Koester, Lee, and Martin (2017) show that the filing date is only one event, albeit an important one, in a string of events that occur when a company gets into legal trouble. By design, we are not capturing any additional value lost in these other events. In our setting, longer event windows produce larger effects, but, to minimize the potential impact of confounding events, we restrict ourselves to the short event windows above.

In the bottom panel in Figure 4, we plot the cumulative abnormal returns around the filing of a low-quality lawsuit separately for innovative and non-innovative firms. High-innovation firms are defined as firms which rank in the top tercile of firms within the same industry and year, respectively, based on their KPSS innovation measure in the calendar year prior to the filing, conditional on the KPSS measure being non-zero. No-innovation firms are those with zero patents granted in the previous calendar year. Consistent with the idea that litigation is costlier for firms with attractive growth opportunities, we see a larger drop for high-innovation firms. Over days (-3,+3), the drop in market value is 2.8% for innovative firms and thus about 1.0 percentage points higher than for non-innovative firms.

Table 6 confirms the result that abnormal stock returns around lawsuit filings are lower for innovative firms in an OLS regression with the same set of control variables and fixed effects as in Table 2, specifications (2) and (5). If anything, the difference gets larger once we control for potentially confounding variables. The point estimates in specification (2) suggest that a one-standard-deviation increase in innovation value leads to a 1.4 ($= 0.241 \times 0.060$) percentage points lower abnormal stock return.

If firms with valuable innovations were smaller than their peers, higher percentage losses would not necessarily translate into higher dollar losses. In the data, however, we find the opposite. Among targeted firms, successful innovators have an average market capitalization of around $14.0 billion, which is much larger than the $2.2 billion average market capitalization for non-innovators. The larger percentage losses that we document above thus fall on larger firms.

A potential concern about the above estimates could be that stock prices revert as the market learns about lawsuit merit. To investigate this, we examine abnormal returns around the dismissal date, which on average occurs more than two years after the filing date. We find average abnormal returns of 0.1% in the seven days around the lawsuit dismissal, which is economically small and statistically indistinguishable from zero ($t = 0.30$) (results unreported for brevity). As shown in Table 6, columns (3) and (4), firms with high innovation output in the year prior to the

low-quality cases. This has no bearing on our central point: being target of a low-quality class action lawsuit is very costly in terms of shareholder value.

lawsuit filing tend to have more positive abnormal returns around the dismissal date. However, the difference is not statistically different from zero and economically much smaller than the difference around the lawsuit filing. There is thus very little evidence for a meaningful reversal around the dismissal date. In Internet Appendix IA.E, we further use a calendar-time portfolio approach to examine long-run returns after a filing. We find no evidence of a reversal in the first eight months following the initial lawsuit filing. This suggests that the shareholder-value losses documented above are long-lasting.

6.8.2 Potential Sources of Shareholder Value Losses around Lawsuit Filings

The above results establish that the losses to shareholders around the filing of a low-quality lawsuit are economically substantial. For the average firm in our sample of targeted firms, the 2.1% loss in market value in the (-3,+3) window around the filing date of a low-quality lawsuit translates into a dollar-value loss of $109M. What are the exact sources behind these losses, and what is their relative contribution? While fully answering this question is beyond the scope of our study, and left for future research, we consider three potential sources in this section.

A first source of value reduction are direct legal costs associated with the lawsuit. Unfortunately, large-scale data on defense counsel costs are scarce. Survey evidence suggests a median range for direct legal costs for outside lawyers working on class action lawsuits of around $1M for more routine cases, and up to $30M for very complex cases (Carleton Fields (2016), p. 17). We conclude that direct legal costs are non trivial and may explain a considerable fraction of the shareholder value loss associated with class action filings for smaller firms. But, for larger firms, direct legal costs are unlikely to explain the bulk of the shareholder value loss associated with class action filings.

A second potential source of firm-value reduction are expected settlement costs. One way to derive an upper bound estimate of the impact of expected settlement costs is as follows: if the market had no information regarding the outcome of a specific lawsuit, the average settlement amount ($27M) multiplied with the average probability that the lawsuit is not dismissed (56%) would yield a shareholder value loss of around $15M. This represents only about 14% of the market value loss of the average firm ($109M), which would suggest expected settlement costs are not a major driver of observed losses around filings of low-quality lawsuits. This estimate is an upper bound in the following sense: the better the market is able to predict dismissals, the lower are the expected settlement costs for cases which ultimately end up being dismissed. In the limiting case in which markets can perfectly predict which cases will end up being dismissed, expected settlement costs for these cases are zero, and can therefore not contribute to the loss in market value for low-quality cases we observe in the data. On the other hand, if the market cannot perfectly predict dismissals, and if expected settlement costs would be substantial, then we would expect to see large positive returns around the lawsuit dismissal date. Since this is not the case, the combined evidence in this paragraph argues against expected settlement costs being a major driver of the observed shareholder value losses around lawsuit filing dates.

We note that Directors & Officers (D&O) Insurance may cover some or all of the direct legal fees and settlement costs for many cases. This would suggest that shareholder value losses must be driven by other factors, over and above direct legal costs, settlement costs, and other costs covered by D&O insurance.

Existing research suggests that reputation costs induced by shareholder lawsuits may drive shareholder value losses. A widely held view is that, for cases of actual wrongdoing, reputation costs are of central importance. For example, Karpoff, Lee, and Martin (2008) estimate that reputation costs alone make up on average two thirds of the decline in shareholder value associated with financial misconduct. Consistent with this idea, survey evidence based on 385 U.S. firms documents that reputation concerns and potential business implications rank among the most important risk factors firms cite in connection with class action lawsuits (e.g., Carleton Fields (2018), p. 23).

In our setting, reputation costs may be high even for allegations which turn out to be meritless, for at least two reasons. First, customers, suppliers, providers of capital, and employees may not know with great certainty whether a case is meritless or meritorious at the filing of the case. Thus, while the case is pending, this can lead to reduced demand for a firm's products, worsened terms of trade, higher cost of capital, worsened access to trade credit, and lower employee morale, which may all inflict a permanent value loss on affected firms. Second, even after a case is dismissed, having been accused of wrongdoing may impart a persistent stigma on firms. Prior research suggests this is not implausible. For example, in line with a permanent reputation effect for targeted firms, Deng, Willis, and Xu (2014) document a deterioration in loan terms after a securities class action lawsuit is filed against a firm, which, for the most part, do not reset to pre-suit levels after the case is dismissed. Our evidence above is consistent with the view that, just like for high-quality suits, reputation costs are an important driver of the observed value losses for low-quality class action lawsuits.

7 Does Class Action Litigation Risk Affect Firms' Innovation Decisions?

The results so far indicate that valuable innovation output increases the risk of being subject to costly, low-quality class action lawsuits. In this section, we ask whether firms take into account litigation risk in their innovation decisions. In particular, we are interested in whether changes in litigation risk affect the quantity and economic value of corporate innovation output.

If the valuable innovation hypothesis holds, we expect two things to happen in response to an exogenous increase in litigation risk. First, if an increase in litigation risk increases the likelihood of a costly innovation-related class action lawsuit, then the aggregate expected economic value of a firms' patents should decrease. Second, as the litigation-related risk associated with patenting increases, firms may have, all else equal, an incentive to reduce the number of patents they apply for.

To overcome pertinent endogeneity issues in analyzing these channels, we explore how firms respond to exogenous changes in federal class action litigation risk. To that end, we follow Huang, Hui, and Li (2019) and look at the composition of judicial benches to elicit a measure of litigation risk. Specifically, we exploit changes in judge ideology of the federal circuit court whose jurisdiction covers the firms' headquarters.[24] We measure a circuit court's judge ideology as the probability that a panel consisting of three randomly chosen federal judges is dominated by appointees of Democratic presidents. The underlying motivation is that political views have been shown in prior work to possess significant predictive power for a judge's tendency to be business-friendly in their rulings. We conjecture that, all else equal, firms in a circuit with a less business-friendly court would be more attractive litigation targets. Identification comes from two features. First, changes in judge ideology are driven by death or voluntary retirement decisions of federal judges, since federal judges cannot be fired or otherwise forced out of office, which implies that the timing of changes should be unrelated to economic fundamentals that might affect corporate innovation patters. Second, we compare corporate innovation patterns across circuits at the same point in time, which implies that general changes in innovation patterns across time (which may coincide with changes in government) cannot affect our results.

We test our above hypotheses by estimating the following regression:

$$\mathcal{I}_{ijk,t+h} = \lambda_{jt} + \lambda_k + \beta LibCourt_{kt} + \gamma X_{it} + \epsilon_{ijk,t+h}, \tag{5}$$

where $\mathcal{I}_{ijkt}$ refers to the KPSS measure of innovation output (and alternative measures below) of firm i in industry j located in circuit court k in year $t+h$, scaled by lagged total assets. We vary h from one to five years. λ_{jt} are industry $\times$ year fixed effects, and $LibCourt_{kt}$ refers to the probability that a panel composed of three randomly drawn judges from circuit court k in year t is dominated by appointees of Democratic presidents. We follow Huang, Hui, and Li (2019) and include circuit court fixed effects (λ_k) to control for potential circuit-level omitted variables that are correlated with $LibCourt$. Effectively, we are thus focusing on changes in $LibCourt$ within circuit court. X_{it} is the same vector of control variables included in column (5), Panel A, of

[24] We are grateful to Professor Reeyarn Zhiyang Li for sharing the measure of federal judge ideology. We refer the reader to Huang, Hui, and Li (2019) for details on the construction of the judge ideology variable, as well as detailed explanation on the measure's motivation and grounding in prior research.

Table 2.[25]

Table 7 presents results. Each coefficient in Table 7 represents a separate regression and we omit results on the control variables for brevity. Panel A shows that an increase in litigation risk brought about by more liberal federal judges leads to a decrease in the private economic value of patents granted. As shown in Panel A, this effect becomes stronger over time. By year five, our estimates imply that replacing a judge appointed during a Republican presidency by a judge appointed during a Democratic presidency on a three-judge panel (i.e., an increase in *LibCourt* of 1/3) would reduce the scaled KPSS measure by 0.7 (=–0.021 × 1/3) percentage points, which is large relative to its mean of 2.4 percent. The effect on the aggregate economic value of the firm's patents is even larger and more immediate when we align patents by when they were filed, not by when they were granted (Panel B). Here, we observe a decrease in the scaled KPSS measure by 1.2 (=–0.037 × 1/3) percentage points in year five.

Several not mutually exclusive factors may contribute to explaining the results in Panels A and B. First, higher litigation risk and associated litigation costs should decrease the aggregate economic value of a firms' patents. Second, firms may file fewer patents. Third, learning about judges' investor friendliness by firms and investors may contribute to the more pronounced effects in later years.

In Panel C, we directly test whether firms patent less following an increase in *LibCourt*. The results show that fewer granted patents after an increase in litigation risk can help explain the drop in innovation value from Panel A in the later years, but not in the earlier years. The fact that we do not observe any significant effect on the number of patents granted in the early years provides a useful placebo test, because with an average application-to-grant duration of about three years, patents granted in those years were most likely filed before the change in *LibCourt*. Panel D also looks at the number of patents, but, in contrast to Panel C, it aligns patents by when they were filed, not by when they were granted. The results show that an increase in litigation risk indeed leads firms to patent substantially less, an effect that is partly obscured by the time-lag between patent application and patent grant in Panel C. Increasing *LibCourt* by 1/3, as above, the results imply that the number of patents filed decreases by 14% (=–0.428 × 1/3) by year five. This is a strong result, because it shows that firms actively alter their innovation patterns in response to a change in litigation risk.

Finally, we also explore the effect on the average economic value per patent granted or filed. Note that the sign of the effect of an increase in litigation risk, as proxied by *LibCourt*, on the average economic value per patent is theoretically ambiguous. On the one hand, for any

[25] The maintained assumption underlying our tests, in line with Huang, Hui, and Li (2019) and the substantial body of evidence cited in their paper, is that an increase in *LibCourt* increases *ex-ante* litigation risk, i.e., the risk of being subject to a lawsuit if firms did not change their behavior in response to the change in *LibCourt*. Whether, *ex post*, the observed number of lawsuits increases when *LibCourt* increases is a different question, theoretically ambiguous, and inconsequential for our analysis.

hypothetical patent, higher litigation costs should reduce the economic value of the patent. On the other hand, selection effects may increase the average economic value per patent filed. If firms no longer file patents with low expected economic value, because these are precisely the patents which may become negative NPV after the increase in litigation costs, then this would lead to an increase in the average value per patent.

We find that the first effect dominates. In Panel E, we see that the average economic value per patent granted decreases substantially – by 44% (=–1.320 × 1/3) – by year five. We obtain a very similar point estimate when we look at the average economic value per patent filed, except that the effect shows up even faster.

In sum, the results in Table 7 are consistent with the view that increasing the risk of class action litigation is detrimental to the value of innovation produced in the economy.

The above tests have advantages, but they also have limitations. A noteworthy limitation is that we cannot distinguish between meritless and meritorious lawsuits in this section. While we would expect judges' political views not to matter in cases that are obviously frivolous or obviously meritorious, more business friendly judges may, on the margin, have an increased tendency to not dismiss harder to judge cases, both meritorious and meritless. The tests therefore do not *directly* show the effects of an increase in the risk of a meritless lawsuit, which would be the ideal experiment in our setting. We nevertheless argue that, combined with the other evidence in our paper, the most plausible interpretation of the above results is that an increase in the risk of being subject to a meritless lawsuit, which is captured by *LibCourt*, leads firms to alter their innovation patterns. Two facts in particular support this view. First, we have shown earlier in our paper that firms with more valuable innovation are more likely to become targets of meritless class actions, but we have found no such evidence for meritorious cases. The valuable innovation hypothesis thus offers a common framework to understanding the results in this and earlier sections: if firms with valuable innovation are more likely subject to meritless class actions (as seen in Table 2), then an increase in the risk of such litigation should disincentivize producing valuable innovation (as seen in Table 7). By contrast, it is not clear why firms would alter their innovation patterns in response to an increase in the risk of meritorious litigation if more innovation is not associated with more meritorious lawsuits in the first place. Second, we examine directly in Internet Appendix IA.F whether firms with higher innovation values are more likely to commit fraud. The evidence indicates that they don't.

8 Conclusion

It has long been suspected by academics, practitioners, and lawmakers, that corporate innovation and low-quality shareholder litigation, i.e., litigation that has an elevated likelihood of being without legal merit, may be intrinsically linked. A common narrative is that innovation projects have high uncertainty and may, in the case of project failure, increase the likelihood of a large stock drop. A large stock drop, in turn, may trigger a lawsuit filing – irrespective of actual wrongdoing. This view stands in contrast with existing empirical studies that have failed to document a causal link between innovation inputs, as measured by R&D expenditures, and subsequent litigation. Moreover, the empirical fact that large "litigable" stock drops occur much more frequently than class action lawsuits (56% vs. 2% for the average firm-year in our sample) suggests that stock drops can at best provide a partial explanation for why firms become targets of class action lawsuits.

In this paper, we propose and test a new perspective on the link between innovation and class action litigation, which we label the "valuable innovation hypothesis." The valuable innovation hypothesis holds that low-quality class action lawsuits specifically target successful innovators, because such firms are attractive targets for low-quality class action litigation *conditional* on a stock drop. The core conceptual contribution of the valuable innovation hypothesis is to emphasize the distinction between innovation inputs, like R&D expenditures, and innovation outputs, which we measure as the economic value of granted patents in a given firm-year following Kogan, Papanikolaou, Seru, and Stoffman (2017). This distinction allows us to reconcile the fact that practitioners and policy makers perceive innovation to be an important driver of low-quality litigation with the lack of strong evidence for an innovation-litigation link in the existing literature. We show that once we focus on innovation output, there is a strong empirical link between innovation and subsequent low-quality class action litigation, consistent with a theoretical model we also develop in this paper. By contrast, if we follow prior work and focus on innovation input, we find essentially no relation between innovation and low-quality litigation. Exploiting judge turnover in federal courts, we also show that changes in class action litigation risk affect the value and number of patents filed, suggesting that firms take into account class action litigation risk in their innovation decisions.

Our study focuses on innovation output due to its documented importance for economic growth as well as empirical advantages, such as measurement and identification.[26] However, it is plausible that a more general systematic link exists between corporate success and low-quality litigation. Specifically, we argue that firms with valuable innovation output may be more attractive litigation targets because they (i) face high opportunity costs, and (ii) use more forward-looking

[26] We observe patent grants perfectly, and we can estimate the value of an innovation with some accuracy using the KPSS approach. We can thus attribute our findings directly to a firm's innovation success. The fact that patent grants occur on average years after the firm conducted the research and filed the patent, allows us to decouple corporate actions relating to the investment in innovation, i.e., innovation input, and investors' learning about the innovation, from innovation output as measured by patent grants. Those advantages set innovation apart from other potential variables of growth opportunities such as, for example, Tobin's Q or investment, which may reflect many things over and above growth opportunities that could give an incentive for lawyers to target the firm via low-quality class action litigation, and for which it seems harder to find reasonable instruments.

and optimistic language in their communication with investors. Since most positive shocks to future cash flows, e.g., in the form of a new positive NPV project, are likely to change a firm's characteristics along these dimensions, the U.S. litigation system may systematically punish firms with the most attractive growth opportunities. If the tax on valuable innovation output we identify in this paper is reflective of a broader "tax on valuable growth opportunities," the overall economic costs of low-quality class actions are potentially even larger than we estimate them to be. Of course, some of our arguments may also apply to other types of litigation, which would further increase the possible economic costs associated with low-quality litigation against innovative firms. We leave exploring the link between low-quality litigation and growth opportunities more broadly to future research.

Our results contribute new evidence to the important ongoing debate on the efficiency of the U.S. securities class action litigation system. Overall, the findings support the view that certain features of the system may be an impediment to corporate innovation and, ultimately, economic growth. To avoid misunderstandings, a word of caution is in order: of course our results do not imply that all securities class action litigation is meritless. Nor do our results imply that class action litigation should generally be discouraged. Securities class action lawsuits can be socially beneficial; for example, if they deter wrongdoing, curb managerial rent extraction, and compensate injured shareholders. Designing a well-functioning securities class action system requires carefully balancing the benefits and costs of the system and its features. Our paper contributes to this policy goal by providing new evidence on the potential costs of securities class actions.

References

Abrams, David, Ufuk Akcigit, and Jillian Grennan, 2019, Patent value and citations: Creative destruction or strategic disruption?, *Working Paper*.

Alexander, Janet Cooper, 1991, Do the merits matter: A study of settlements in securities class actions, *Stanford Law Review* 43, 497.

Ali, Ashiq, and Sanjay Kallapur, 2001, Securities price consequences of the Private Securities Litigation Reform Act of 1995 and related events, *The Accounting Review* 76, 431–460.

American Bar Association, 2017, Letter to the Committee on the Judiciary of the U.S. House of Representatives, Re: Lawsuit Abuse Reduction Act of 2017, Available at https://www.americanbar.org.

Bebchuk, Lucian Arye, 1988, Suing solely to extract a settlement offer, *Journal of Legal Studies* 17, 437–450.

Bloom, Nicholas, Mark Schankerman, and John Van Reenen, 2013, Identifying technology spillovers and product market rivalry, *Econometrica* 81, 1347—-1393.

Bondi, Bradley J., 2010, Facilitating economic recovery and sustainable growth through reform of the securities class-action system: Exploring arbitration as an alternative to litigation, *Harvard Journal of Law & Public Policy* 33, 607.

Carhart, Mark M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57–82.

Carleton Fields, 2016, The 2016 Carlton Fields Class Action Survey: Best Practices in Reducing Cost and Managing Risk in Class Action Litigation, *https://ClassActionSurvey.com.*

——— , 2018, The 2018 Carlton Fields Class Action Survey: Best Practices in Reducing Cost and Managing Risk in Class Action Litigation, *https://ClassActionSurvey.com.*

Choi, Stephen J., 2007, Do the merits matter less after the Private Securities Litigation Reform Act?, *Journal of Law, Economics, & Organization* 23, 598–626.

——— , A. C. Pritchard, and Jill E. Fisch, 2005, Do institutions matter? The impact of the lead plaintiff provision of the Private Securities Litigation Reform Act, *Washington University Law Review* 83, 869–905.

Cohen, Lauren, Umit G. Gurun, and Scott D. Kominers, 2016, The growing problem of patent trolling, *Science* 352, 521–522.

——— , 2019, Patent trolls: Evidence from targeted firms, *Management Science* 65, 5461–5486.

Congressional Record Volume 141, 1995, pp. S12201–S12207.

Crane, Alan D., and Andrew Koch, 2018, Shareholder litigation and ownership structure, *Management Science* 64, 5–23.

Deng, Saiying, Richard H. Willis, and Li Xu, 2014, Shareholder litigation, reputational loss, and bank loan contracting, *Journal of Financial and Quantitative Analysis* 49, 1101—-1132.

Dyck, Alexander, Adair Morse, and Luigi Zingales, 2010, Who blows the whistle on corporate fraud?, *Journal of Finance* 65, 2213–2253.

——— , 2017, How pervasive is corporate fraud?, *Working Paper*.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Field, Laura, Michelle Lowry, and Susan Shu, 2005, Does disclosure deter or trigger litigation?, *Journal of Accounting and Economics* 39, 487–507.

Francis, Jennifer, Donna Philbrick, and Katherine Schipper, 1994, Shareholder litigation and corporate disclosures, *Journal of Accounting Research* 32, 137–164.

Gande, Amar, and Craig M. Lewis, 2009, Shareholder-initiated class action lawsuits: Shareholder wealth effects and industry spillovers, *Journal of Financial and Quantitative Analysis* 44, 823–850.

Griffin, Paul A., Joseph A. Grundfest, and Michael A. Perino, 2004, Stock price response to news of securities fraud litigation: An analysis of sequential and conditional information, *Abacus* 40, 21–48.

Huang, Allen, Kai W. Hui, and Reeyarn Z. Li, 2019, Federal judge ideology: A new measure of ex ante litigation risk, *Journal of Accounting Research* 57, 431–489.

Johnson, Marilyn F., Ron Kasznik, and Karen K. Nelson, 2000, Shareholder wealth effects of the private securities litigation reform act of 1995, *Review of Accounting Studies* 5, 217–233.

Karpoff, Jonathan M., Allison Koester, D. Scott Lee, and Gerald S. Martin, 2017, Proxies and databases in financial misconduct research, *The Accounting Review* 92, 129–163.

Karpoff, Jonathan M., D. Scott Lee, and Gerald S. Martin, 2008, The cost to firms of cooking the books, *Journal of Financial and Quantitative Analysis* 43, 581–611.

Kasznik, Ron, and Baruch Lev, 1995, To warn or not to warn: Management disclosures in the face of an earnings surprise, *The Accounting Review* 70, 113–134.

Kaufman, Bruce, 2017, Bill targets 'frivolous' suits, but critics say it misses mark, *Bloomberg Law,* https://www.bna.com/bill-targets-frivolous-n57982087297/.

Kim, Irene, and Douglas J. Skinner, 2012, Measuring securities litigation risk, *Journal of Accounting and Economics* 53, 290—-310.

Klock, Mark, 2016, Do the merits matter less after the Private Securities Litigation Reform Act?, *Journal of Business & Securities Law* 15, 110–156.

Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman, 2017, Technological innovation, resource allocation, and growth, *Quarterly Journal of Economics* 132, 665–712.

Lemley, Mark, and Bhaven Sampat, 2012, Examiner characteristics and patent office outcomes, *Review of Economics and Statistics* 94, 817–827.

Lerner, Josh, and Amit Seru, 2017, The use and misuse of patent data: Issues for corporate finance and beyond, *Working Paper*.

Lin, Chen, Sibo Liu, and Gustavo Manso, 2019, Shareholder litigation and corporate innovation, *Management Science* forthcoming.

Malmendier, Ulrike, and Geoffrey Tate, 2005, CEO overconfidence and corporate investment, *Journal of Finance* 60, 2661–2700.

Matray, Adrien, and Johan Hombert, 2018, Can innovation help U.S. manufacturing firms escape import competition from China?, *Journal of Finance* 73, 2003–2039.

McKinsey & Company, 2007, Sustaining New York's and the U.S.' global financial services leadership, *Report commissioned by Mayor Michael R. Bloomberg and Charles E. Schumer*.

Mezzanotti, Filippo, 2020, Roadblock to innovation: The role of patent litigation in corporate R&D, *Management Science* forthcoming.

Mukherjee, Abhiroop, Manpreet Singh, and Alminas Žaldokas, 2017, Do corporate taxes hinder innovation?, *Journal of Financial Economics* 124, 195 – 221.

Peters, Ryan H., and Lucian A. Taylor, 2017, Intangible capital and the investment-Q relation, *Journal of Financial Economics* 123, 251–272.

Pritchard, Adam C., and Stephen P. Ferris, 2001, Stock price reactions to securities fraud class actions under the private securities litigation reform act, *Michigan Law and Economics Research Paper No. 01-009*.

Rogers, Jonathan L., Andrew Van Buskirk, and Sarah L. C. Zechman, 2011, Disclosure tone and shareholder litigation, *The Accounting Review* 86, 2155–2183.

Romano, Roberta, 1991, The shareholder suit: Litigation without foundation?, *Journal of Law, Economics, & Organization* 7, 55–87.

Sampat, Bhaven, and Heidi L. Williams, 2019, How do patents affect follow-on innovation? Evidence from the human genome, *American Economic Review* 109, 203–236.

Seligman, Joel, 1994, The merits do matter: A comment on Professor Grundfest's disimplying private rights of action under the Federal Securities Laws: The Commission's authority, *Harvard Law Review* 108, 438.

———, 2004, Rethinking private securities litigation, *University of Cincinnati Law Review* 73, 95–138.

Spiess, D. Katherine, and Paula A. Tkac, 1997, The Private Securities Litigation Reform Act of 1995: The stock market casts its vote..., *Managerial and Decision Economics* 18, 545–561.

U.S. Chamber Institute for Legal Reform, 2014, Economic consequences: The real costs of U.S. securities class action litigation, Available at https://www.instituteforlegalreform.com/research/economic-consequences-the-real-costs-of-us-securities-class-action-litigation.

——— , 2017, Unstable foundation: Our broken class action system and how to fix it, Available at https://www.instituteforlegalreform.com/research/unstable-foundation-our-broken-class-action-system-and-how-to-fix-it.

U.S. Chamber of Commerce, 2017, Letter to the Committee on the Judiciary of the U.S. House of Representatives, Available at https://www.uschamber.com/letter/hr-720-the-lawsuit-abuse-reduction-act-2017.

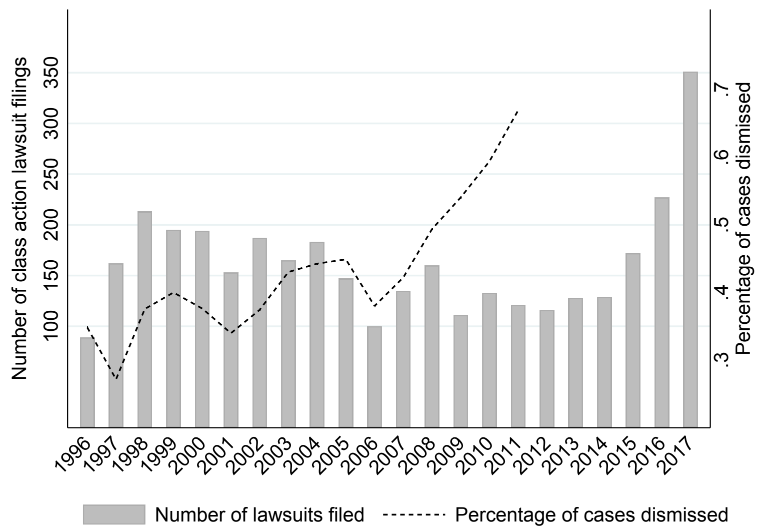
Wang, Tracy Yue, 2013, Corporate securities fraud: Insights from a new empirical framework, *Journal of Law, Economics, and Organization* 29, 535–568.

——— , and Andrew Winton, 2014, Product market interactions and corporate fraud, *Working Paper*.

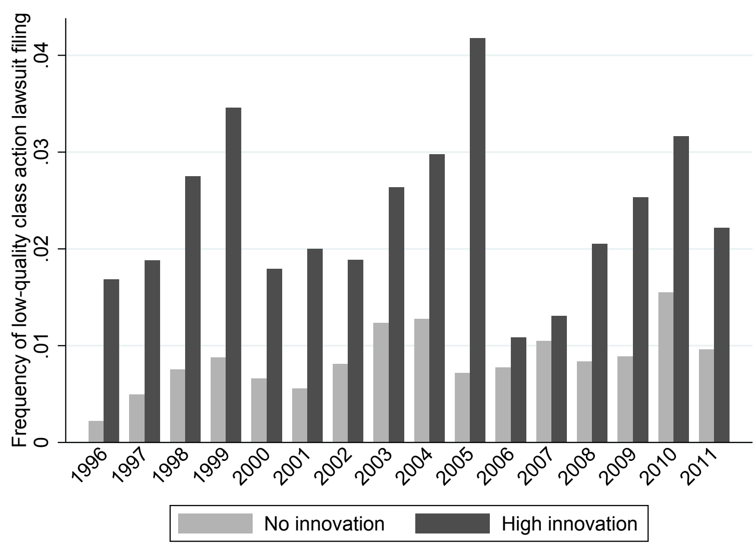
——— , and Xiaoyun Yu, 2010, Corporate fraud and business conditions: Evidence from IPOs, *Journal of Finance* 65, 2255–2292.

Wilson, Daniel J., 2009, Beggar thy neighbor? The in-state, out-of-state, and aggregate effects of R&D tax credits, *Review of Economics and Statistics* 91, 431–436.

Zingales, Luigi, 2006, Chapter 1: Competitiveness, *Interim Report of the Committee on Capital Markets Regulation*.

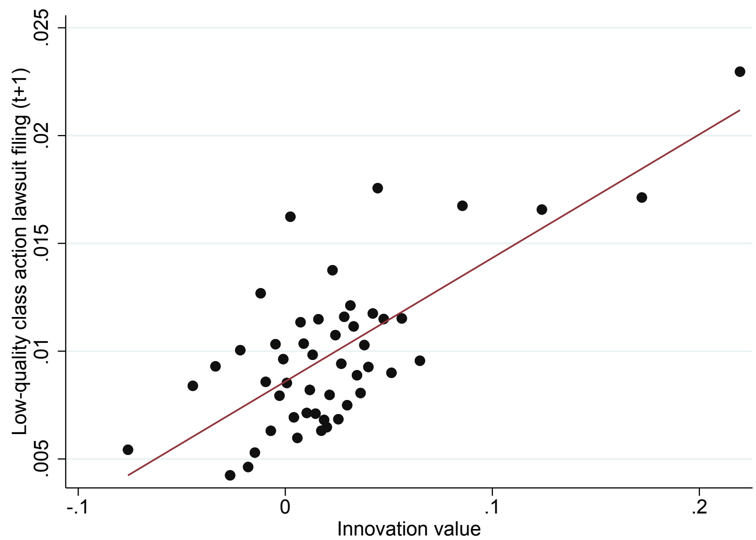


(A) Number of Lawsuits Filed and Frequency of Dismissal

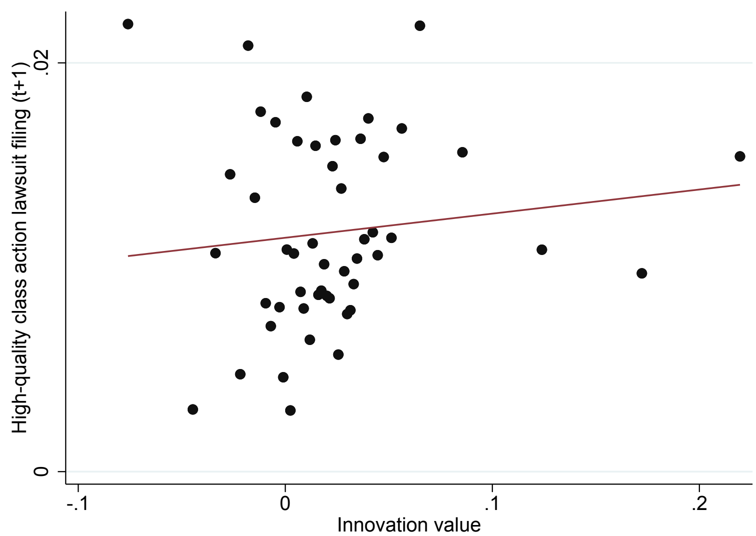


(B) Frequency of Low-Quality Lawsuits by Innovation

Figure 1: Securities class action filings over time.
Panel A presents the total number of securities class action lawsuit filed in a given calendar year, and the fraction of these cases which are subsequently dismissed. Panel B presents the frequency of dismissed (i.e., low-quality) class action lawsuit filings over time for two groups of firms: high innovators and non-innovators. We sort all firms with positive innovation value in the previous calendar year into terciles within the same SIC 2-digit industry and year. High innovation are firms which rank in the top tercile. Low innovation firms are those with zero innovation in the previous calendar year. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017).

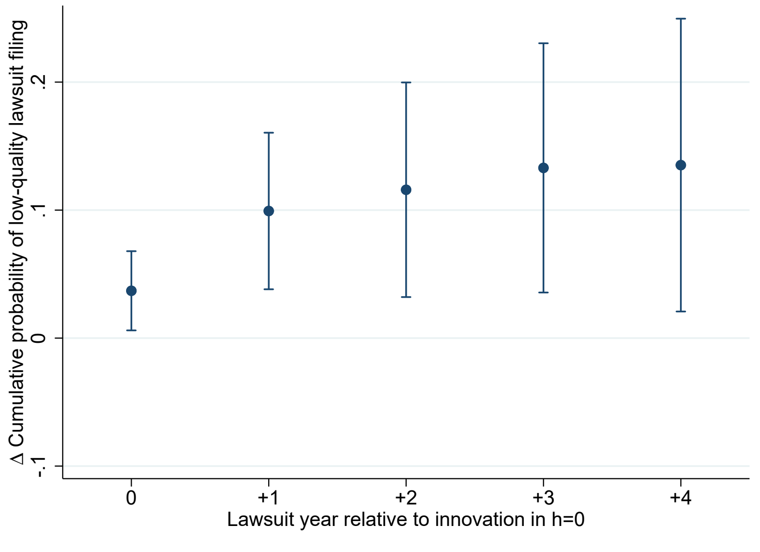


(A) Low-Quality Lawsuits

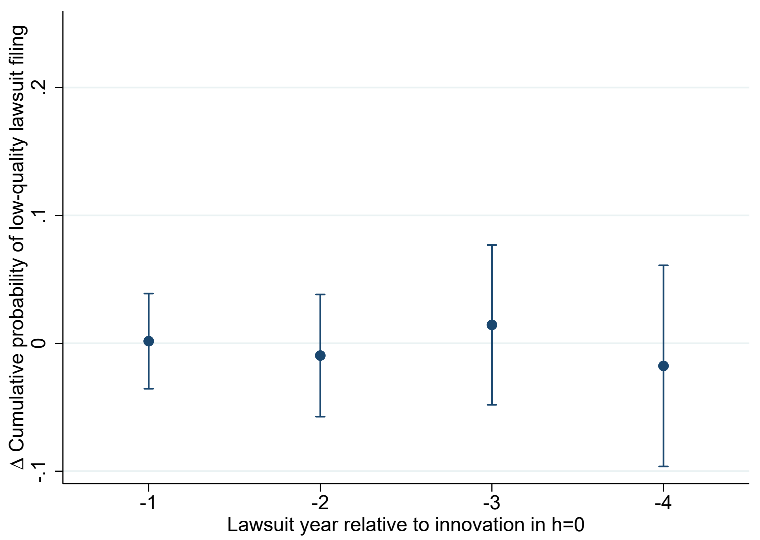


(B) High-Quality Lawsuits

Figure 2: Valuable innovation and next-period class action lawsuit filing.
The figure presents nonparametric binned scatter plots of the relationship between the probability of a class action lawsuit filing in the following year and valuable innovation in the current year. We sort firms' innovation value into 50 equal-sized bins and plot the average frequency of observing a low-quality (Panel A) and high-quality (Panel B) class action lawsuit filing in the following calendar year against the average innovation value measure within each bin. The lawsuit and innovation variables are first residualized on industry × year dummies and the set of control variables presented in Table 2, Panel A, specifications (5) and (6). The best-fit line is estimated with an OLS regression using the underlying micro data. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017). Low-quality lawsuits are identified as lawsuits that are eventually dismissed; all other lawsuits are classified as high-quality.

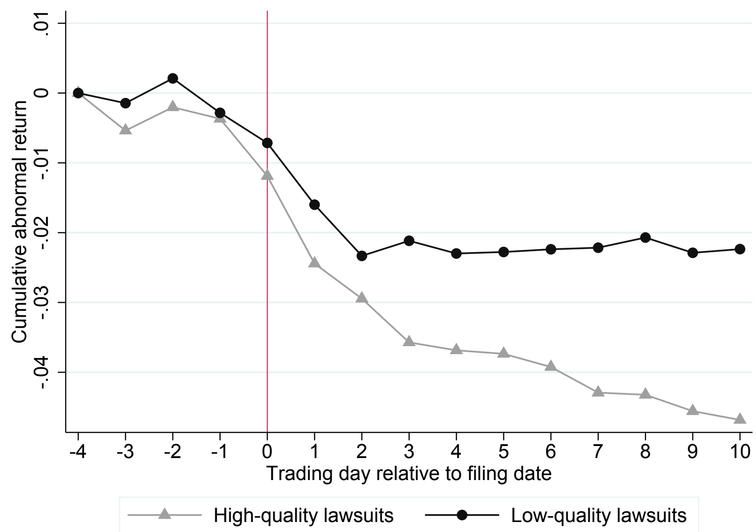


(A) Innovation and Future Lawsuit Propensity

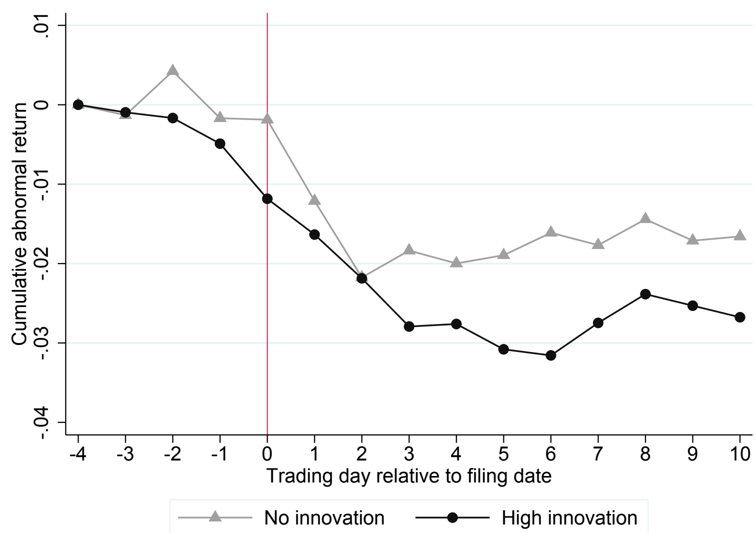


(B) Innovation and Past Lawsuit Propensity (Placebo)

Figure 3: Dynamic effects of valuable innovation on low-quality litigation risk. Panel A plots the coefficients and corresponding 95% confidence intervals from a dynamic analysis of the effect of valuable innovation in t on the cumulative low-quality litigation risk in years t to $t+h$, for each $h = 0, 1, 2, 3, 4$, based on Equation (3). Panel B presents the analogous plot for $h = -1, -2, -3, -4$, based on Equation (4).



(A) All Lawsuits



(B) Low-Quality Lawsuits Only

Figure 4: Cumulative abnormal returns around class action lawsuit filings.
Panel A shows the cumulative abnormal returns over event days (-3,+10) around the filing of a low-quality versus high-quality lawsuit. Low-quality lawsuits are identified as lawsuits that are eventually dismissed; all other lawsuits are classified as high-quality. Panel B shows the cumulative abnormal returns over event days (-3,+10) around the filing of a low-quality class action lawsuit, separately for high innovators and non-innovators. High innovation refers to firms which rank in the top tercile of all firms in the same industry and year, based on their measure of valuable innovation in the prior calendar year. No innovation refers to firms with zero innovation in the prior calendar year. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017). Abnormal returns are estimated based on the Fama and French (1993) and Carhart (1997) 4-factor model estimated over days $t = -300$ to $t = -50$.

Table 1: Summary Statistics

This table presents summary statistics for key variables. Securities class action lawsuits are retrieved from the Stanford Securities Class Action Clearinghouse database from 1996 to 2011. Low-quality lawsuits are identified as lawsuits that are eventually dismissed; all other lawsuits are classified as high-quality. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017), scaled by lagged book assets.

	N	Mean	Std. Dev.	0.25	Median	0.75
Dependent Variables						
Class action lawsuit filing$_{t+1}$	40,010	0.022	0.146	0.000	0.000	0.000
Low-quality class action lawsuit filing$_{t+1}$	40,010	0.010	0.099	0.000	0.000	0.000
High-quality class action lawsuit filing$_{t+1}$	40,010	0.012	0.108	0.000	0.000	0.000
Key Independent Variables						
Innovation value$_t$	40,010	0.024	0.060	0.000	0.000	0.010
R&D$_t$	39,987	0.057	0.105	0.000	0.003	0.072
R&D$_{(t-2,t)}$	40,010	0.058	0.102	0.000	0.004	0.077
Control variables						
Tobin's Q$_{t-1}$	40,010	2.039	1.651	1.099	1.496	2.283
Log assets$_{t-1}$	40,010	5.478	2.042	3.971	5.340	6.809
Cash$_{t-1}$	40,010	0.189	0.218	0.025	0.096	0.283
Sales growth$_{t-1}$	40,010	0.170	0.513	-0.024	0.087	0.237
Sales growth$_{t-2}$	40,010	0.221	0.577	-0.003	0.105	0.271
IO$_{t-1}$	40,010	0.447	0.294	0.174	0.453	0.703
Stock return$_{t-1}$	40,010	0.191	0.642	-0.162	0.153	0.480
Stock return$_{t-2}$	40,010	0.154	0.628	-0.189	0.121	0.442
Return skewness$_{t-1}$	40,010	0.491	1.112	0.017	0.401	0.866
Return skewness$_{t-2}$	40,010	0.459	1.078	0.013	0.381	0.819
Return volatility$_{t-1}$	40,010	0.639	0.356	0.383	0.557	0.800
Return volatility$_{t-2}$	40,010	0.631	0.351	0.377	0.553	0.792
Turnover$_{t-1}$	40,010	17.573	18.761	5.585	11.552	22.745
Turnover$_{t-2}$	40,010	16.873	18.313	5.387	10.946	21.592

Table 2: Innovation and Class Action Lawsuit Filings

This table regresses indicators for next-period class action lawsuit filings on the value of this period's (t) innovation output. Low-quality lawsuits are identified as lawsuits that are eventually dismissed; all other lawsuits are classified as high-quality. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017), scaled by lagged book assets. Baseline controls include lagged Tobin's Q, log total assets, cash holdings, two lags of annual sales growth, and lagged institutional ownership. Additional controls include two lags of average monthly stock return, return skewness, return volatility, and turnover. In Panel B, we also control for the firm's R&D expenditures in t and, in Panel C, for a moving average of R&D expenditures measured over years $t-2$ to t. R&D expenditures are scaled by lagged assets and replaced by zero if R&D expenditures are missing. t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

Panel A: Baseline

	Class action lawsuit filing$_{t+1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Low-quality	High-quality	All	Low-quality	High-quality
Innovation value$_t$	0.084	0.064	0.019	0.070	0.057	0.012
	(3.65)	(3.94)	(1.18)	(3.00)	(3.50)	(0.73)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.033	0.024	0.040	0.035	0.025
N	40,010	40,010	40,010	40,010	40,010	40,010

Panel B: Innovation output versus innovation input

	Class action lawsuit filing$_{t+1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Low-quality	High-quality	All	Low-quality	High-quality
Innovation value$_t$	0.080	0.064	0.016	0.067	0.057	0.009
	(3.44)	(3.83)	(0.99)	(2.83)	(3.44)	(0.55)
R&D$_t$	0.009	0.002	0.008	0.009	0.000	0.008
	(0.87)	(0.20)	(0.98)	(0.80)	(0.05)	(1.03)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.033	0.024	0.040	0.035	0.025
N	39,987	39,987	39,987	39,987	39,987	39,987

Panel C: Innovation output versus 3-year average innovation input

	Class action lawsuit filing$_{t+1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Low-quality	High-quality	All	Low-quality	High-quality
Innovation value$_t$	0.078	0.063	0.014	0.066	0.058	0.007
	(3.31)	(3.80)	(0.84)	(2.77)	(3.45)	(0.44)
R&D$_{(t-2,t)}$	0.018	0.003	0.015	0.013	-0.001	0.014
	(1.47)	(0.36)	(1.62)	(1.09)	(-0.08)	(1.50)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.033	0.024	0.040	0.035	0.025
N	40,010	40,010	40,010	40,010	40,010	40,010

Table 3: Valuable Innovation and Lawsuit-Triggering Events

This table regresses next-period stock return volatility, return skewness, an indicator for extreme low returns, and an indicator for extreme negative earnings surprises, on this period's innovation value. Stock return volatility and return skewness are computed based on daily stock returns during any given firm-year. Extreme negative return is an indicator equal to one if the first percentile of daily stock returns of a firm is in the bottom 5% across all firms in the same calendar year. Negative earnings surprise is an indicator equal to one if the firm's most negative quarterly earnings surprise is in the bottom 5% across all firms in the same calendar year. Earnings surprises are computed as the difference between the announced quarterly EPS and the consensus forecast from IBES, scaled by the stock price at the end of the previous calendar quarter. Control variables are the same as in Table 2, as well as one lag of the dependent variable. t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

	Return volatility$_{t+1}$	Return skewness$_{t+1}$	Extreme negative return$_{t+1}$	Negative earnings surprise$_{t+1}$
	(1)	(2)	(3)	(4)
Innovation value$_t$	-0.060	-0.171	0.007	-0.015
	(-2.86)	(-1.43)	(0.43)	(-0.62)
Baseline Controls	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes
R^2	0.670	0.125	0.131	0.103
N	37,721	37,721	37,387	19,047

Table 4: Ex-Ante Proxies for Lawsuit Merit

This table regresses indicators for next-period class action lawsuit filings on valuable innovation output. In specification (1) ((2)), the dependent variable is equal to one if a lawsuit is filed that (does not) coincide or was (not) preceded by an SEC investigation of an accounting restatement by the firm, respectively. In specification (3) ((4)), the dependent variable is equal to one if a lawsuit is filed that alleges (does not allege) a U.S. GAAP violation, respectively. In specification (5) ((6)), the dependent variable is equal to one if a lawsuit is filed that is predicted to have a high (low) chance of dismissal. Dismissal is predicted using the linear probability model presented in Table IA.4, column (2), and lawsuits are classified as having a high (low) chance of dismissal after splitting at the median within a given filing year. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017), scaled by lagged book assets. Control variables are the same as in Table 2, specification (5). t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

Panel A: Baseline

	Class action lawsuit filing$_{t+1}$					
	SEC action		GAAP violation		Predicted dismissal	
	No	Yes	No	Yes	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Innovation value$_t$	0.063	0.007	0.061	0.008	0.052	0.005
	(2.94)	(0.79)	(3.13)	(0.60)	(3.66)	(0.44)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.017	0.034	0.026	0.026	0.022
N	40,010	40,010	40,010	40,010	40,010	40,010

Panel B: Innovation output versus innovation input

	Class action lawsuit filing$_{t+1}$					
	SEC action		GAAP violation		Predicted dismissal	
	No	Yes	No	Yes	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Innovation value$_t$	0.061	0.006	0.058	0.009	0.052	0.004
	(2.81)	(0.66)	(2.90)	(0.65)	(3.59)	(0.35)
R&D$_t$	0.006	0.003	0.011	-0.003	-0.002	0.003
	(0.55)	(0.86)	(1.23)	(-0.42)	(-0.36)	(0.54)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.017	0.034	0.026	0.026	0.022
N	39,987	39,987	39,987	39,987	39,987	39,987

Panel C: Innovation output versus 3-year average innovation input

	Class action lawsuit filing$_{t+1}$					
	SEC action		GAAP violation		Predicted dismissal	
	No	Yes	No	Yes	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Innovation value$_t$	0.060	0.005	0.057	0.008	0.052	0.002
	(2.77)	(0.61)	(2.88)	(0.59)	(3.60)	(0.19)
R&D$_{(t-2,t)}$	0.009	0.004	0.014	-0.000	-0.003	0.008
	(0.77)	(1.04)	(1.37)	(-0.04)	(-0.39)	(1.27)
Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.037	0.017	0.034	0.026	0.026	0.022
N	40,010	40,010	40,010	40,010	40,010	40,010

Table 5: Alternative Measures of Innovation Output and Robustness

This table presents results for alternative measures of innovation output as well as robustness tests. The baseline regression refers to specification (5) from Table 2, Panel A. For brevity we only report coefficients of interest and suppress control variables. Economic effects are calculated as the reported coefficient multiplied by the standard deviation of the key independent variable, divided by the mean of the dependent variable. In Panel A, number of patents is defined as the logarithm of one plus the total number of patents granted, citation-weighted patent counts, the number of patents granted which rank in the top decile of patents in the same technology class and year by ex-post citations, and the market value of new product introductions is defined as in Mukherjee, Singh, and Žaldokas (2017). In Panel B, we define low-quality lawsuits as all lawsuits that are either dismissed or settle for less than $3 million (first row); as all dismissed lawsuits that are not based on voluntary dismissal (second row); and as all dismissed lawsuits filed for violation of Section 10(b) or Section 11 of the Securities Acts (third row). In Panel C, we add additional controls. CEO overconfidence is measured as in Malmendier and Tate (2005). In Panel D, we impose sample restrictions. First, we restrict the sample to firms with at least one patent in a given calendar year. Then we estimate the regression for different subperiods.

	Coeff.	*t*-statistic	Econ. Effect	N
Baseline	0.057	(3.50)	33.4%	40,010
Panel A: Alternative Measures of Innovation Output				
Number of patents	0.002	(2.23)	18.2%	40,010
Citation-weighted patent counts	0.001	(2.17)	17.1%	40,010
Patents in top 10% of citations	0.007	(2.06)	16.2%	40,010
New product introductions	0.026	(1.86)	21.0%	40,010
Panel B: Alternative Measures of Low-quality Lawsuit				
Dismissal or settlement <$3m	0.056	(3.10)	24.0%	40,010
Exclude voluntary dismissal	0.054	(3.42)	30.7%	40,010
Only Sec 10b and Sec 11 claims	0.053	(3.34)	31.7%	40,010
Panel C: Additional Controls				
Contemporaneous sales growth and stock return variables	0.042	(2.75)	23.5%	46,868
CEO overconfidence	0.060	(2.33)	34.0%	13,473
Firm fixed effects	0.056	(1.93)	31.6%	39,089
District × year fixed effects	0.056	(3.36)	31.5%	39,800
Panel D: Sample Restrictions				
Non-zero innovation	0.041	(3.20)	46.9%	12,963
Exclude 2000–2001	0.064	(3.27)	36.0%	34,098
Subperiod: 1996–2000	0.068	(2.91)	55.5%	15,625
Subperiod: 2001–2010	0.047	(2.41)	23.8%	24,385

Table 6: Valuable Innovation and Cumulative Abnormal Returns Around Class Action Lawsuit Filing and Dismissal

This table regresses cumulative abnormal returns around the filing and dismissal of low-quality class action lawsuits on valuable innovation measured during the year prior to lawsuit filing. Cumulative abnormal returns are measured over event days (-3,+3), where abnormal returns are estimated based on the Fama and French (1993) and Carhart (1997) 4-factor model estimated over days $t = -300$ to $t = -50$. Low-quality lawsuits are identified as lawsuits that eventually get dismissed. Control variables are the same as in Table 2, specification (5). t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

	Cumulative abnormal return (-3,+3)			
	Filing		Dismissal	
	(1)	(2)	(3)	(4)
Innovation value$_t$	-0.235	-0.241	0.044	0.081
	(-1.97)	(-1.81)	(0.53)	(0.99)
Baseline Controls	Yes	Yes	Yes	Yes
Additional Controls	No	Yes	No	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes
R^2	0.432	0.464	0.296	0.359
N	213	206	251	240

Table 7: Federal Judge Ideology and Innovation Output

This table regresses measures of innovation output on federal judge ideology. In Panels A and D, we estimate:

$$\mathcal{I}_{ijk,t+h} = \lambda_{jt} + \lambda_k + \beta LibCourt_{kt} + \gamma X_{it} + \epsilon_{ijk,t+h}, \tag{6}$$

where h varies between one and five years, $\mathcal{I}$ is innovation value, λ_{jt} are 2-digit-SIC industry $\times$ year fixed effects, λ_k are circuit-court fixed effects, and X_{it} is a vector of control variables that includes the same variables as the controls in Table 2, specification (5). *LibCourt* refers to the as the probability that Democratic presidents' appointees dominate a panel of three judges randomly selected from the circuit, obtained from Huang, Hui, and Li (2019). We use the logarithm of one plus the total number of patents as dependent variables in Panels C and D, and the logarithm of the average economic value per patent in Panels E and F. t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

Innovation horizon				
1	2	3	4	5
Panel A: Innovation value of patents granted				
-0.006	-0.010	-0.015	-0.020	-0.021
(-1.54)	(-2.25)	(-3.05)	(-3.65)	(-3.65)
Panel B: Innovation value of patents filed				
-0.028	-0.031	-0.036	-0.038	-0.037
(-4.46)	(-4.37)	(-4.66)	(-4.78)	(-4.51)
Panel C: Log of (1 + number of patents granted)				
0.089	0.006	-0.042	-0.139	-0.245
(0.99)	(0.07)	(-0.48)	(-1.46)	(-2.30)
Panel D: Log of (1 + number of patents filed)				
-0.077	-0.131	-0.215	-0.317	-0.428
(-1.01)	(-1.61)	(-2.36)	(-2.98)	(-3.47)
Panel E: Log of economic value per patent granted				
-0.373	-0.486	-0.870	-1.241	-1.320
(-3.55)	(-3.43)	(-4.65)	(-5.49)	(-5.21)
Panel F: Log of economic value per patent filed				
-0.843	-1.111	-1.250	-1.138	-1.242
(-4.33)	(-4.84)	(-4.90)	(-4.20)	(-4.56)

Appendix

A.1 Variable Descriptions

Table A.1: Variable descriptions

Variable	Description
Dependent variables	
Class action lawsuit filing$_{t+1}$	Indicator variable equal to one if a securities class action lawsuit is filed against the firm in the following calendar year, and zero otherwise. Securities class action lawsuits are retrieved from the Stanford Securities Class Action Clearinghouse database.
Low-quality class action lawsuit filing$_{t+1}$	Indicator variable equal to one if a low-quality securities class action lawsuit is filed against the firm in the following calendar year, and zero otherwise. Class action lawsuits are defined as low-quality if they result in a dismissal of all claims, as indicated in the Stanford Securities Class Action Clearinghouse database.
High-quality class action lawsuit filing$_{t+1}$	Indicator variable equal to one if a high-quality securities class action lawsuit is filed against the firm in the following calendar year, and zero otherwise. Class action lawsuits are defined as high-quality if they do not result in a dismissal of all claims, as indicated in the Stanford Securities Class Action Clearinghouse database.
Key independent variables	
Innovation value$_t$	The aggregate economic value of the patents granted to the firm by the USPTO during the calendar year, divided by lagged total assets. The economic value of a patent is calculated as in Kogan, Papanikolaou, Seru, and Stoffman (2017) and the annual aggregated measure is obtained from Professor Stoffman's website.
R&D$_t$	Research and development expenditures scaled by total book assets and replaced by zero if research and development expenditures are missing. Balance sheet information is obtained from Compustat Annual, using the most recent fiscal-year-end in a given calendar year t.
R&D$_{(t-2,t)}$	Three-year moving average of research and development expenditures scaled by total book assets and replaced by zero if research and development expenditures are missing. Balance sheet information is obtained from Compustat Annual, using the most recent fiscal-year-end in a given calendar year.
Control variables – Firm characteristics	
Tobin's Q$_{t-1}$	Ratio of the market to the book value of assets as of the most recent fiscal year end in the prior calendar year.
Log assets$_{t-1}$	Logarithm of total book assets as of the most recent fiscal year end in the prior calendar year.
Cash$_{t-1}$	Cash plus receivables, normalized by total book assets, as of the most recent fiscal year end in the prior calendar year.

Continued on next page

Table A.1 – continued

Variable	Description
Sales growth$_{t-1}$	Annual growth in total revenue as of the most recent fiscal year end in the prior calendar year.
Sales growth$_{t-2}$	Annual growth in total revenue as of the most recent fiscal year end in the second prior calendar year.
Inst. ownership (IO)$_{t-1}$	Fraction of the firm's stock owned by institutional investors as reported in the Thomson Reuters 13f database, measured at the end of the prior calendar year.
Control variables – Stock characteristics	
Stock return$_{t-1}$	Average monthly stock return during the prior calendar year. Monthly stock returns are obtained from CRSP.
Stock return$_{t-2}$	Average monthly stock return during the second prior calendar year. Monthly stock returns are obtained from CRSP.
Return skewness$_{t-1}$	Skewness of daily stock returns during the prior calendar year. Daily stock returns are obtained from CRSP.
Return skewness$_{t-2}$	Skewness of daily stock returns during the second prior calendar year. Daily stock returns are obtained from CRSP.
Return volatility$_{t-1}$	Volatility of daily stock returns during the prior calendar year. Daily stock returns are obtained from CRSP.
Return volatility$_{t-2}$	Volatility of daily stock returns during the second prior calendar year. Daily stock returns are obtained from CRSP.
Turnover$_{t-1}$	Average monthly stock turnover during the prior calendar year. Monthly stock turnover is computed as total trading volume divided by the average number of shares outstanding. Monthly trading volume and shares outstanding are obtained from CRSP.
Turnover$_{t-2}$	Average monthly stock turnover during the second prior calendar year. Monthly stock turnover is computed as total trading volume divided by the average number of shares outstanding. Monthly trading volume and shares outstanding are obtained from CRSP

A.2 Deriving the Predictions of the Model in Section 4

We provide derivations in different order than in the paper for ease of exposition. We keep the labelling and numbering consistent with the main text.

Channel 1 (higher innovation output lowers filing costs for the plaintiff):

Prediction 1: Across all K firms, increasing innovation output makes it more likely that a lawsuit is filed.

Proof: Denote by k^* the lowest quality level k which satisfies $(1-p_d(k))^2 > c$. Let innovation output lower filing costs c to $c_{\text{new}} < c$. Denote the lowest value of k that satisfies $(1-p_d(k))^2 > c_{\text{new}}$ by k_{new}. Because $p_d(k)$ decreases in k, we have $k_{\text{new}} < k^*$.[27] In all firm-law firm pairs for which the law firm found it profitable to file a suit in the baseline case when filing costs are c, the law firm still finds it profitable to file a suit when innovation output is high and costs are $c_{\text{new}} < c$. In the high innovation case there are, however, $k^* - k_{\text{new}} = N$ instances in which a case is filed for a firm-law firm pair, which would not be filed in the baseline case in which the filing costs are c. Hence, the total number of cases filed increases by N and the probability of a filing across all K firms increases by

$$\Delta \Pr(\text{filed}) = \frac{N}{K} > 0. \tag{7}$$

$\square$

Main Prediction: Across all K firms, the chance of being subject to a lawsuit that is dismissed increases as innovation output increases.

Proof: Out of the N additional cases that are filed when innovation output is high and filing costs are c_{new}, a fraction $\overline{p_d^{\text{new}}}$ is dismissed. $\overline{p_d^{\text{new}}}$ is the average dismissal probability across the N new cases and is given by

$$\overline{p_d^{\text{new}}} = \frac{1}{N} \sum_{k=k_{\text{new}}}^{k^*} p_d(k). \tag{8}$$

Because all of the N new cases are from the group where $0 < p_d(k) < 1$, we have that $0 < \overline{p_d^{\text{new}}} < 1$. Hence, the total number of cases that are dismissed increases by $\overline{p_d^{\text{new}}} N > 0$ and the probability of seeing a dismissed case across all K firms increases by

$$\Delta \Pr(\text{filed\&dismissed}) = \frac{\overline{p_d^{\text{new}}} N}{K} > 0. \tag{9}$$

[27] We disregard the trivial case $k_{\text{new}} = k^*$, because it is a pure artefact of our discrete modelling structure without economic content.

$\square$

Prediction 2: Across all K firms, the chance of being subject to a lawsuit that is not dismissed increases as innovation output increases.

Proof: Following the logic of the proof for the main prediction, the total number of cases that are filed and not dismissed increases by $(1-\overline{p_d^{\text{new}}})N$, and the probability of seeing a case that is filed and not dismissed across all K firms increases by

$$\Delta \Pr(\text{filed\&non-dismissed}) = \frac{(1-\overline{p_d^{\text{new}}})N}{K} > 0. \tag{10}$$

$\square$

Denote by N_{old} and $\overline{p_d^{\text{old}}}$ the number of cases filed, and the average dismissal probability, respectively, in the baseline scenario. The *relative* increase in the number of dismissed lawsuits is given by:

$$\frac{\overline{p_d^{\text{new}}}N/K}{\overline{p_d^{\text{old}}}N_{\text{old}}/K}, \tag{11}$$

and the *relative* increase in the number of non-dismissed lawsuits is given by:

$$\frac{(1-\overline{p_d^{\text{new}}})N/K}{(1-\overline{p_d^{\text{old}}})N_{\text{old}}/K}. \tag{12}$$

We can derive the following prediction:

Prediction 3': Across all K firms, as innovation increases, the relative increase in the chance of being subject to a lawsuit that is dismissed is larger than the relative increase in the chance of being subject to a lawsuit that is not dismissed.

Proof:

$$\frac{\overline{p_d^{\text{new}}}N}{\overline{p_d^{\text{old}}}N_{\text{old}}} > \frac{(1-\overline{p_d^{\text{new}}})N}{(1-\overline{p_d^{\text{old}}})N_{\text{old}}} \tag{13}$$

can be rewritten as

$$\frac{\overline{p_d^{\text{new}}}}{(1-\overline{p_d^{\text{new}}})} > \frac{\overline{p_d^{\text{old}}}}{(1-\overline{p_d^{\text{old}}})}, \tag{14}$$

which holds if $\overline{p_d^{\text{new}}} > \overline{p_d^{\text{old}}}$, i.e., if the average quality of the new cases is lower than the average quality of the old cases. This is true by construction of our model.

$\square$

Note that Prediction 3 in the main text is broader than Prediction 3' above, because Prediction 3 does not restrict only to the ratio of relative increases. In the following, we derive the prediction that the absolute increase in the chance of being subject to a lawsuit that is dismissed is larger than the absolute increase in the chance of being subject to a lawsuit that is not dismissed. Combined with Prediction 3' above, this motivates Prediction 3 in the main paper.

We start by computing the ratio of the increase in dismissed and non-dismissed cases as:

$$\frac{\Delta \Pr(\text{filed\&dismissed})}{\Delta \Pr(\text{filed\&non-dismissed})} = \frac{\overline{p_d^{\text{new}}}}{(1 - \overline{p_d^{\text{new}}})}. \tag{15}$$

This expression is greater than one, and $\Delta \Pr(\text{filed\&dismissed}) > \Delta \Pr(\text{filed\&non-dismissed})$ if $\overline{p_d^{\text{new}}} > 0.5$, i.e., if the average dismissal probability of the *additional* cases brought when innovation output increases is larger than 50%.

We can use the data to inform us on whether $\overline{p_d^{\text{new}}}$ is likely greater than, or smaller than, 50%. In the data used in this paper, the average dismissal rate is close to 50% (=0.010/0.022) (see Table 1). This average rate is a weighted average of the dismissal rate for cases of actual wrongdoing (e.g., Enron, Worldcom) and cases of lower quality. Since the average dismissal rate among cases of actual wrongdoing should be very low (e.g., dismissing the Enron case seems like a very unlikely event), the average dismissal probability among those cases that are of lower quality needs to be substantially higher than 50%. Importantly, under the assumptions of our model, all of the N additional cases that now get filed when innovation lowers the cost of filing a suit are of *lower quality than even the worst case out of all cases that have been filed and dismissed in the baseline case*. Hence, the data strongly suggest that $\overline{p_d^{\text{new}}} > 0.5$. Using our baseline estimates from Table 2, columns (5) and (6), in Equation (15) implies that $\overline{p_d^{\text{new}}}$ is around 83%.

Channel 2 (innovation affects litigation costs for the defendant):

This extended model implies that, as of time $t = 0$, the law firm will file a suit if

$$(1 - p_d(k))(1 - p_d(k) + \gamma C_I) > c. \tag{16}$$

It turns out that, despite this altered profitability condition, all four predictions from Channel 1 go through essentially unaltered.

Prediction 1: Across all K firms, increasing innovation output makes it more likely that a lawsuit is filed.

Proof: Denote by k^* the lowest quality level k which satisfies $(1 - p_d(k))^2 > c$. Denote the lowest value of k that satisfies $(1 - p_d(k))(1 - p_d(k) + \gamma C_I) > c$ by k_{new}. Because $p_d(k)$ decreases in k, we have $k_{\text{new}} < k^*$. In all firm-law firm pairs for which the law firm found it profitable to file a suit in the baseline case, where $C_I = 0$, the law firm still finds it profitable to file a suit when $C_I > 0$. With $C_I > 0$, however, there are $k^* - k_{\text{new}} = N$ instances in which a case is filed for a firm-law firm pair which would not be filed in the baseline case ($C_I = 0$). Hence, the total number of cases filed increases by N and the probability of a filing across all K firms increases by

$$\Delta \Pr(\text{filed}) = \frac{N}{K} > 0. \tag{17}$$

$\square$

Main Prediction: as above.

Proof: as above.

Prediction 2: as above.

Proof: as above.

Prediction 3: as above.

Proof: as above.

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