Litigating Innovation: Evidence from Securities Class Action Lawsuits

Finance Working Paper N° 614/2019
December 2019

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ECGI Working Paper Series in Finance

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We would like to thank Brian Fitzpatrick, Wei Jiang (discussant), Louis Kaplow, Jonathan Karpo , Scott Kominers (discussant), Christian Leuz, Ann Lipton, Elena Pikulina (discussant), Emanuele Rizzo, Doug Skinner, Tom Wollmann, Luigi Zingales, and participants at AFA, Berkeley Law, Boston University, Chicago Booth, Federal Reserve Bank of New York, Frankfurt School of Finance, Goethe University, Harvard Law, NBER SI Law and Economics, Northwestern Kellogg, Tilburg University, Toronto Law, Tulane University, UNC Junior Finance Roundtable, University of Mannheim, and University of St. Gallen for valuable comments. We thank Jyothsni Gondesi and Zichen Zhao for excellent research assistance. Kempf gratefully acknowledges financial support from the James S. Kemper Foundation at the University of Chicago Booth School of Business.

Abstract

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

JEL Classifications: G38, K22, K41, O31, O32

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December 9, 2019

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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 provides novel evidence suggesting that a central pillar of the U.S. litigation and corporate governance system, securities class action lawsuits, impose sizable costs on firms with valuable innovation. Specifically, using data from the Stanford Securities Class Action Clearinghouse (SCAC) on class action lawsuits filed against public U.S. companies between 1996 and 2011, and using the private economic value of a firm's newly granted patents as a measure of valuable innovation, we show that valuable corporate innovation increases the likelihood of being the target of a low-quality class action lawsuit.[1] Our findings suggest that low-quality class action litigation represents an undesirable byproduct of value-creating corporate innovation, which has important implications for our understanding of the potential real effects of the current litigation system.

The idea that lawyers can abuse the class action system by bringing low-quality cases against innovative firms is wide-spread 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 the abuse 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. In the extreme, such cases are filed by law firms even in the absence of any violation of the law in an effort to extract a settlement from firms wishing to avoid a costly legal dispute. See Section 3 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 (2017) 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,

Despite being influential and intuitively appealing, there are two empirical facts which cast doubt on 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 comes from 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. As a case in point, Kim and Skinner (2012) conduct a large-scale investigation into the drivers of class action litigation and find that R&D expenditures do not predict class action litigation. This raises fundamental questions about whether innovation links to class action litigation in the first place. Second, as an empirical matter, 56% of all Compustat firms experience a stock drop of at least 10% in any given year of our sample period, but only 2% of Compustat 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 provide at best a partial explanation for why certain firms are targeted with a lawsuit. This raises the question whether, conditional on a stock drop, innovative firms may be more likely subject to meritless litigation. Overall, our understanding of the relation between innovation and litigation is much more limited than casual observation of the topic may suggest.

The purpose of this paper is to address the challenges above and, in doing so, provide 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. As we show in a simple theoretical framework, several reasons could explain why successful innovators are attractive targets, including that managers who are busy growing their firms have high opportunity costs, 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.

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 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

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, because cutting-edge research and the risks inherent in development 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.

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. 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.

While we pay particular attention to identification issues in our main empirical analysis, the key finding of our paper is reflected already in the raw data. Figure 1 shows the annual likelihood of being targeted with a low-quality class action lawsuit for two groups of firms: firms with and without valuable innovation output, defined within 2-digit SIC industry and year, and based on the KPSS measure of innovation value measured over the previous calendar year. We use dismissal of a case as our baseline proxy for case quality, but we show that our main result also obtains for a variety of alternative proxies for lawsuit quality that have been proposed in the literature. The results are striking: in every year in our sample, successful innovators are several times more likely to be target of a low-quality lawsuit than other firms in the same industry and year.

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 alternative 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.

We estimate the incremental cost of valuable innovation, measured as the loss in shareholder value due to the increased risk of low-quality class action litigation for a one-standard-deviation change in innovation value, to be around $0.9 million per year for the average firm in our sample. To put this number into perspective, note that it represents 2.4% of the increase in profits due to the innovation over the next five years. As an alternative way to gauge the economic significance of these estimates, we show below that the expected costs from low-quality class action lawsuits after valuable innovation is 1.6 times as large as the unconditionally expected settlement amounts from all class action lawsuits in our sample. Although the idea that low-quality class action lawsuits act as a "litigation tax" on innovative firms is not new – Senator Domenici already made this claim back in 1995 – ours is, to the best of our knowledge, among the first attempts to quantify the cost of law-quality lawsuits for innovative firms in a comprehensive large-scale sample.

As a final step in our paper, we examine why firms with valuable innovation have an elevated risk of being targeted by low-quality litigation. One potential explanation is that firms with valuable innovation are more likely to subsequently experience stock drops. This mechanism is consistent with a modified version of the risky innovation hypothesis, which assumes that patents which are judged to be extremely valuable by the market have an elevated chance of generating large subsequent disappointment for investors. Using a range of measures such as volatility, skewness, indicators for extreme negative returns, and indicators for missing earnings targets, we do not find any evidence to support this alternative version of the risky innovation view: firms with valuable innovation are, if anything, less likely to experience large subsequent stock drops.

If firms with valuable innovation output do not experience more lawsuit-triggering events, a natural explanation for our findings may be that firms with valuable innovation output are more attractive firms to sue, conditional on experiencing a negative outcome. We provide a simple theoretical framework that illustrates innovative firms could be more attractive litigation targets for two reasons. First, firms with valuable innovation output may face higher litigation costs in the form of opportunity costs, such as the costs from foregone investment opportunities. Second, the cost of filing a low-quality lawsuit against an innovative company may be lower. On way this could happen is that firms with valuable patents use more optimistic and more forward-looking language in their communication with investors, which is easier for lawyers to attack.

To provide support for the idea that firms with valuable innovation output could face higher opportunity costs, we show that the original finding of KPSS, that firms with valuable innovations make additional investments into capital and labor, and grow both output and profits, obtains also in our dataset. This plausibly increases the attractiveness of a firm as a litigation target for two reasons. First, firms that invest into capital and labor, and are therefore busy growing their operations, have particularly high opportunity cost on managerial time and corporate resources. Second, firms that are in the process of marketing new products are particularly vulnerable to bad publicity. In addition to providing a potential explanation for higher litigation risk, both of these channels are consistent with our finding that innovative firms lose more of their market value conditional on getting sued.

We also find evidence consistent with corporate communication as a potential driver of litigation risk. We show that successful innovators use more optimistic language in their annual reports and more forward-looking statements in the MD&A section of their annual reports when valuable patents are granted. This is intuitive, given that valuable innovations are expected to generate substantial value during the years of the patents' protection, and given that managers may speak more, and more optimistically, about those innovations expected to add substantial value to the firm. Rogers, Buskirk, and Zechman (2011) provide direct evidence on a link between optimistic language and subsequent litigation, suggesting that optimistic statements when valuable patents are granted to a firm are easier targets for low-quality lawsuits.

In sum, we advance a novel perspective on understanding the economic link between corporate innovation and low-quality class action lawsuits. Our findings suggest that such lawsuits lead to economically sizeable losses for highly innovative firms, which raises many important questions for managers, lawyers, judges, and policy makers. A key new insight we propose is that we need to think beyond innovation risk and innovation failure, which were emphasized in prior work, if we want to understand the link between innovation and low-quality class action litigation. Focusing on successful innovation in the form of economically valuable innovation output can significantly add to our knowledge about this important link.

More broadly, our findings have potentially important implications for understanding how securities class action litigation can affect the competitiveness of the U.S. economy. First, by draining resources, such as financial capital, reputational capital, and managerial time, from productive firms precisely when these companies are about to implement their new ideas, low-quality class action lawsuits can contribute to economy-wide misallocation of resources. Second, ex-post punishment of firms that generate valuable innovation, in the form of a costly meritless lawsuit, may distort innovation incentives for all firms *ex ante*, which can lead to underprovision of innovation in the economy. Finally, costs incurred due to shareholder litigation may lead innovative firms to refrain from listing on public stock markets and thus forego otherwise valuable growth opportunities – an argument in line with both anecdotal and prior academic evidence on class action lawsuits as an impediment to tapping public equity markets (e.g., Zingales (2006)).

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. Huang, Hui, and Li (2019), while not distinguishing between meritless and meritorious class actions, find that a higher likelihood of facing investor-friendly judges in a federal district court reduces shareholder

[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 (2014).

[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).

value.

Our findings on the link between innovation success 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 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 two important ways. First, we identify our effects of innovation success 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 the relation between innovation and class action litigation, a point which, to the best of our knowledge, is new to this literature.

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 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 (2017) use a natural experiment to show that innovative activity increases when the threat of shareholder derivative lawsuits in state-courts decreases. Our study complements theirs in two key respects. First, we study federal class action lawsuits, while they study state-level derivative lawsuits. Second, their study is very informative for policy makers who want to understand the impact of a particular law change on innovation. However, by design, their study cannot provide direct evidence on the channel that links litigation to innovation, and, in particular, on whether there is a causal relation from innovation to low-quality litigation. Our study is therefore incrementally informative for managers and their innovation decisions, as well as for policy makers who want to learn more about the channel that links litigation to innovation in order to determine optimal policy design.

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 (2018) 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 (2017) 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. Figure 2 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 are in fact untrue (see the model in Appendix B for a simple illustration of the underlying economics). Meritless cases 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. Intuitively, 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.

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 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 Data

4.1 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

[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.

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.[8] 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.[9] The implicit use of expert judgment and non-public case-relevant information are clear 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 2 suggests that low-quality litigation may be an increasingly important problem. In 2011 (the 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.,

[8]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.

[9]Less than 10% of the dismissals in our sample are due to voluntary dismissal. In Table 4, Panel A, we show that our results are robust to excluding voluntary dismissals.

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, we consider a range of alternative definitions below and show that our main results obtain also for these alternative measures.

4.2 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. The KPSS measure is ideal to assess the merits of the valuable innovation hypothesis, since KPSS show their measure is a particularly strong predictor of subsequent growth in employment, capital, output, profits, and revenue-based total factor productivity. 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.[10] We also consider alternatives to the KPSS measure, such as raw and citation-weighted patent counts, in our robustness tests.

[10]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. Our main results are robust to restricting our sample to the post-2000 period.

4.3 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 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 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.

5 Valuable Innovation Output and Shareholder Class Action Lawsuits

This section presents our main results. We will focus first on the effect of valuable innovation output on the likelihood of being the target of a low-quality class action lawsuit. We then estimate the associated costs to shareholders.

5.1 Sorting

We begin with a simple sorting exercise. 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 4.

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. These results motivate our more elaborate tests in the next sections, which aim at establishing a causal link from valuable innovation output to subsequent low-quality litigation.

5.2 Regressions

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

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

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.[11] $X_{i,t-1}$ 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,[12] the log of assets, cash holdings, sales growth, institutional ownership, stock returns, volatility, skewness, and turnover. We use a linear probability model to estimate Equation (1) 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 4; and an indicator for the remaining subset of high-quality lawsuits. Columns (1) to (3) present results using only accounting-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. From a shareholder-value standpoint this is bad news, because being subject to a class action lawsuit is costly (we provide

[11] 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.

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

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 (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%.[13]

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.[14] 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.

To get a better sense of the functional form that relates valuable innovation output to shareholder litigation, Figure 3 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 3 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

[13] 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).

[14] 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 Appendix F.

high-quality litigation is much flatter.

Finally, we also consider the dynamics of the relationship between valuable innovation output and low-quality litigation risk. We estimate the following distributed lags model:

$$y_{ijt} = \lambda_{jt} + \sum_{\tau=-4}^{\tau=0} \beta_\tau \mathcal{I}_{i,t+\tau} + \epsilon_{ijt}. \tag{2}$$

The dependent variable is an indicator for a low-quality lawsuit filed against firm i in year t. The coefficients β_τ thus measure the difference in the probability of a low-quality class action filing between firms with a higher and lower value of innovation output for different lags. The regression does not include any additional controls, because those controls would be endogenous.[15]

Figure 4 presents results. There is a large and statistically significant difference ($t = 2.11$) in the probability of being subject to a low-quality lawsuit between high innovation firms and other firms in the year after a firm was granted economically valuable patents. This reflects our baseline results which have shown that valuable innovation today leads to more low-quality litigation next year. We see a slightly higher point estimate also in the year of the innovation, but that increase is only marginally significant ($t = 1.75$). The concentration of the effect around the first year after the valuable innovation is very informative. In particular, the absence of a difference for further innovation lags suggests that our baseline results are not due to a fixed difference in the litigation propensity between successful innovators and other firms. This dynamic pattern thus substantially increases the hurdle for potential alternative explanations. Any hypothesis that rests on a slow-moving variable being correlated with both innovation value and litigation propensity cannot explain our findings.

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.

5.3 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.

[15] While we believe the above specification is the most appropriate one, we have estimated the regression with the set of controls measured in $t - 5$, and we have also estimated a specification with firm fixed effects added to Equation (2). Both alternatives deliver qualitatively similar results to the specification in Equation (2).

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 makes it testably different from the valuable innovation hypothesis.

We run a horse race between the KPSS measure of innovation output and R&D expenditures as the standard measure of innovation input.[16] 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 when we control for innovation output.

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.

5.4 Alternative 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

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

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 pro-business judges would predict a decrease in the likelihood of a non-dismissed lawsuit, and 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 public information when the case is filed, 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 3, 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 3, 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 Appendix 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 3, 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 3, Panel A, are remarkably consistent across the three alternative proxies for lawsuit quality, and completely in line with our baseline results in Table 2: valuable innovation output leads to more low-quality 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.

5.5 Additional Robustness Tests

To establish that our main result presented in Table 2, Panel A, specification (5), is robust to alternative specifications, we perform a series of robustness tests, all presented in Table 4. In

Panel A, 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)),[17] as well as to excluding voluntary dismissals. 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.

In Panel B, we consider alternative measures of innovation output. The first two lines show that our results are similar if we define an indicator variable for firms in the top tercile of innovation value within their industry and year, or if we scale innovation value by the firm's lagged market capitalization as opposed to by lagged book assets. Next, we use the total number of patents granted to the firm as an alternative measure of innovation output and find a similar effect. We then 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")). Finally, we use the market value of new product introductions as defined by Mukherjee, Singh, and Žaldokas (2017). This measure relies on the intuition that if a press release containing a new product announcement refers to a major innovation, the equity market should respond to the news positively. Overall, we find that our result is robust to alternative measures of innovation output, although the economic magnitude is somewhat lower than for the KPSS measure of innovation output.[18]

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

[17]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.

[18]The ex-post citation measures may be subject to a mechanical downward-bias in our setting because citations accrue only after a patent was granted. If subsequent citations are lower for firms which get into legal trouble (most obviously if the litigation discourages the firm itself or its peers from investing in follow-up inventions), regressing lawsuits on ex-post citations will induce a downward bias. Moreover, Abrams, Akcigit, and Grennan (2013) document that the relationship between citations and economic value follows an inverted U-shape, with fewer citations at the high end of economic value than in the middle. Hence, as also noted by KPSS, the economic value of a patent is correlated with, but different from, the scientific value of a patent. Since the valuable innovation hypothesis emphasizes economically valuable innovation, rather than scientifically valuable innovation, using the KPSS measure is warranted in our setting and, accordingly, we expect stronger results using that measure.

and Tate (2005) and find virtually unchanged results. Third, we use firm fixed effects in order to rule out the potential concern that better-run firms are both, more likely to generate valuable innovations, and less likely to be sued for securities fraud. While including firm fixed effects makes our estimates more noisy, the point estimate and therefore the economic significance of our effects is is virtually unchanged.[19] Finally, by including district court × year fixed effects, we can 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.

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. 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 4, i.e., the sharp increase in litigation risk in the year following the innovation as well as the subsequent decrease. 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

[19]The reason why we prefer not to include firm fixed effects in our baseline regression is that firm fixed effects, while mitigating concerns related to omitted time-invariant variables, may introduce a new problem of reverse causality. In the spirit of the bias identified by Stambaugh (1999) one can show the following: even in a hypothetical scenario where there is no causal effect of innovation output on litigation risk, but there is a causal effect of litigation on future levels of innovation output, one would erroneously find a positive effect of innovation output on litigation risk in the specification with firm fixed effects. The specification without firm fixed effects would not suffer from this problem. Even though our setting is different, the general logic from the above example applies. Our regressions with firm fixed effects would thus be biased if litigation would lead to lower innovation in the future. Because this is not implausible, we do not include firm fixed effects in our baseline tests.

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.[20] 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 any remaining concerns about measurement error, we consider two instruments for innovation value. We provide a condensed discussion here, for brevity, and relegate details to Appendix 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., Kogan, Papanikolaou, Seru, and Stoffman (2017), 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 Appendix D, the first-stage estimates reveal a strong, negative, relation between the firm's R&D user cost and subsequent innovation output, as well as a strong, positive, relationship between patent examiner leniency and innovation output. The coefficient estimates

[20] 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.

in the second-stage regression are larger but qualitatively similar to our baseline results, for both instruments. We conclude that our main results are not due to measurement error in the KPSS innovation measure.

5.6 Quantifying the Costs of Shareholder Litigation

The results in the previous sections show that 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.

5.6.1 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. 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.

Figure 5 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).[21]

[21] 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.

One way to try and capture some of this additional value loss is to expand the event window. If we use an event period of 61 days around the announcement, from day $t = -30$ to day $t = 30$ around the filing date, we find that the losses are substantially larger than those shown in Figure 5 (results unreported for brevity). Interestingly, we observe a large and steady decline in stock prices for low-quality suits until day two after the filing day, but no further decline thereafter. This suggests the lawsuit is not simply a byproduct of a period with bad news; it is more consistent with the market anticipating a costly lawsuit filing because, in that scenario, we should see little return movement after the filing event. The cumulative abnormal return over the (-30,+30) window is around -18% for low-quality lawsuits, consistent with the argument in Gande and Lewis (2009) that focusing on filing dates may understate the value loss. However, a drawback of the long window approach is that it is more likely to capture also the negative fundamental information which triggers the filing of the case, as well as other confounding, but unrelated, pieces of information. To be conservative, we will therefore mainly focus on the tighter (-3,+3) window around the filing date where the end of the class action period is excluded.

In Figure 6, 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 5 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

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.

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 5, columns (3) and (4), firms with high innovation output in the year prior to the 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 Appendix 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.

5.6.2 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.

5.6.3 Ex-Ante Costs of Low-Quality Litigation: A Back-Of-The-Envelope Calculation

To get a sense of the economic magnitude of the additional litigation costs imposed on firms with valuable innovation, consider the following back-of-the-envelope calculation. The increase in expected litigation costs for a change in innovation value has two components. First, valuable innovation increases the likelihood of a low-quality lawsuit. Second, it increases the expected value loss conditional on being litigated. The combined effect of a one-standard-deviation increase in valuable innovation on the expected dollar cost of litigation is therefore given by:

$$\Delta\,\mathrm{E}(\mathrm{cost}_{\mathrm{litigation}}) = \overline{\mathrm{Size}}(\Delta_p(\overline{\mathrm{CAR}} + \Delta_{\mathrm{CAR}}) + \overline{p}\Delta_{\mathrm{CAR}}), \tag{3}$$

where $\overline{\mathrm{Size}}$ refers to the average market capitalization of the firms in our sample, Δ_p refers to the change in the probability of being litigated induced by a one-standard-deviation increase in innovation value, $\overline{\mathrm{CAR}}$ is the average cumulative abnormal stock return around a low-quality lawsuit filing, Δ_{CAR} is the expected increase in the cumulative abnormal stock return induced by a one-standard-deviation increase in innovation value, and $\overline{p}$ refers to the average probability of being target of a low-quality lawsuit. $\overline{\mathrm{Size}}$, $\overline{\mathrm{CAR}}$, and $\overline{p}$ are given by \$3.2 billion, 2.1%, and 1.0%, respectively. Above we have estimated the increase in the cumulative abnormal returns due to a one-standard-deviation increase in innovation value to be 1.4 percentage points, and the increase in the likelihood of being target of a low-quality lawsuit in the following year to be 0.34 percentage points. The cost of a one-standard-deviation increase in innovation value that stems from increased low-quality litigation risk is therefore equal to \$0.9M for the average firm-year. In other words, if all firms in our sample had increased their innovation output by one standard deviation, the aggregate incremental shareholder-value losses over the full sample period would have amounted to \$34 billion (=0.9M × 40,010 firm-years).

To put these numbers into perspective, consider the effect of a one-standard-deviation increase in innovation value on future firm profits. Using the same regression specification as KPSS, we estimate that a one-standard-deviation increase in innovation increases profits by 4.4% (=0.731 × 0.060) over the the next five years (see Table 7, Panel D, which we discuss in greater detail below).[22] Applying this growth rate to the average firm profit in our sample, we estimate that a

[22]KPSS estimate profits to increase by 4.6% for their sample period, which spans the years between 1950 and

one-standard-deviation increase in innovation raises firm profits on average by \$33.9M (=4.4% $\times$ 770M) over the following five years. The costs associated with increased low-quality litigation therefore represent 2.4% (=0.9/33.9) and hence an economically sizable fraction of the increase in profits in the first years.

An alternative point of reference are expected settlement payments for class action lawsuits. For the average firm-year, the settlement amount paid for securities class action lawsuits is equal to \$0.6M. Hence, a one-standard-deviation increase in innovation leads to an increase in expected low-quality litigation costs that is 1.6 times as high as what the average firm can expect to pay in the form of settlements.

Obviously, these numbers are coarse and need to be taken with a grain of salt. They nevertheless indicate that the costs incurred by innovative firms due to increased shareholder litigation are economically sizable.

6 Potential Channels

In this section we examine potential channels to explain why valuable innovation output leads to more low-quality lawsuits. We consider two broad possibilities. First, we test whether valuable innovation output is associated with a greater likelihood of subsequent negative events that may trigger lawsuit filings, such as a large drop in the firm's stock price, or a missed earnings forecast. If lawyers were mechanically filing a lawsuit upon observing a negative event, we would then see more lawsuits for successful innovators. This channel is consistent with a modified version of the risky innovation hypothesis, which assumes that patents which are judged to be extremely valuable by the market have an elevated chance of generating large subsequent disappointment for investors. The second possibility we consider is that valuable innovation output makes firms more attractive litigation targets, conditional on experiencing a negative event.

6.1 Valuable Innovation Output and Lawsuit-Triggering Events

To assess whether successful innovators are more likely to experience negative events such as large stock price drops or unexpectedly poor accounting performance, we analyze the effect of valuable innovation output on daily stock return volatility, skewness, large negative stock returns, and large negative earnings surprises.

Table 6 presents the results. 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, specification (5). Stock volatility is measured as the standard deviation of daily stock returns in a given

2010.

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 in Table 6.

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. Our earlier results from Table 3 are also informative: since we do not observe an increase in lawsuits that allege U.S. GAAP violations following valuable innovation, those results are inconsistent with the explanation that successful innovators are more likely to have accounting restatements, which could be another type of lawsuit-triggering event.

Note that a lawsuit filing could mechanically lead to higher volatility. Hence, the tests in Table 6 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 (2017)) 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.

6.2 The Valuable Innovation Hypothesis: Successful Innovators as Attractive Litigation Targets

An alternative possibility, which we explore in this section, is that successful innovators are more attractive litigation targets. We present a simple theoretical framework to support this perspective in Appendix B. The model shows how valuable innovation could make firms more attractive litigation targets for two reasons: (i) innovation may increase opportunity costs at the defendant firm, and (ii) firms with valuable patents may use more optimistic and more forward-looking statements in their communication with investors, which are easier for lawyers to attack.

We explore these possible channels in more detail below.

6.2.1 Valuable Innovation Output, Firm Growth, and Opportunity Costs

Successful innovators may be attractive litigation targets because managers of firms with valuable innovation output have particularly high opportunity costs on their time and resources. The intuition is that technological innovation allows the firm to grow rapidly, which requires substantial managerial effort and investments and thus makes being subject to a lawsuit particularly burdensome. In addition, firms which are trying to market new products may be more adversely affected by the bad publicity that a class action lawsuit entails. As a result, plaintiff lawyers may believe it is easier to extract a large settlement from successful innovators who are facing higher expected litigation costs. The model in Appendix B (Case 2) captures this intuition more formally. It predicts that, if innovation increases firms' opportunity costs, more innovation should lead to more lawsuits overall, and the increase in lawsuits should be stronger among low-quality suits than among high-quality lawsuits. The model thus captures the key empirical findings of Table 2.[23,24]

Since the opportunity cost of managerial time and company resources is not directly observable, it is inherently hard to test as a potential channel. However, we can provide at least indirect evidence by showing that firms with valuable innovations are subsequently expanding their business, which is plausibly associated with high opportunity costs of managerial time and company resources, and an increased sensitivity to reputational concerns. We use regression specifications from KPSS, in which future growth in the dependent variable over horizons from one to five years is regressed on the value of innovation output today. Following KPSS, we include the current level of the dependent variable, the log of firm capital, the log of employment, and stock return volatility as controls; in addition, we include the control variables from Table 2, specification (5), as well as industry-year fixed effects. Table 7 presents results. Each coefficient in each panel represents a separate regression and we omit results on the control variables for brevity. Consistent

[23]How much low-quality and high-quality cases increase is a function of the average dismissal probability among the incremental cases, i.e., cases that will only be brought if innovation is high. The higher that probability, the more will an increase in innovation affect only low-quality lawsuits. In light of our model, the coefficients in Table 2, columns (5) and (6) imply that incremental cases are of very low quality, with an average dismissal probability of 83% (Equation (13)). This helps explain why we cannot reject the increase to be zero for high-quality suits (taken literally, a zero increase would imply that all incremental suits are dismissed). Whether the dismissal probability for incremental cases is 83% or even higher is not consequential for our overall message.

[24]The model also shows that implementing direct empirical tests on settlements is very challenging. The key reason is that more innovation induces two effects with opposing implications for settlements (see Case 2 in the model in Appendix B for details). On the one hand, for any given case, the expected settlement amount is higher than it otherwise would be. On the other hand, more innovation increases the number of low-quality cases which should, all else equal, lower the average settlement amount per case across all cases. Moreover, it is possible to derive our main predictions in a version of the model in which the former effect is not present, i.e., in which innovation does not increase the settlement amount for any given case (Case 1 in the model). Overall, then, predictions for settlements are theoretically ambiguous, which makes them hard to test.

with the findings by KPSS, Panels A and B show that valuable innovation leads to substantial growth in capital and labor. Panels C and D further show an increase in firm output and profits following a valuable patent grant. These findings support the idea that opportunity costs on time, resources, and reputation are particularly high after successful innovation in the form of valuable patent grants. Note that, because we control for lagged Tobin's Q and sales growth, the results are not simply due to innovative firms being growth firms in general. Innovation success is incrementally important.

In sum, in line with the model in Appendix B, we conclude from Table 7 that the changes in corporate investment and output, induced by valuable innovation output, support the hypothesis that valuable innovation output makes a firm an attractive litigation target because of higher opportunity costs. These findings complement those from Table 5, where we find that innovative firms experience larger declines in their stock price around the lawsuit filing, which is consistent with, and provides additional support for, the opportunity-cost explanation.

6.2.2 Valuable Innovation Output and Corporate Communication

A second channel we consider is that the information disclosed by successful innovators to investors makes it easier for lawyers to craft a case of questionable quality. In particular, if managers of firms that obtain valuable patents use more optimistic and forward-looking language in their communication with investors – which seems plausible given the very nature of valuable innovation – then they could automatically be more vulnerable to being wrong ex post. Effectively, then, the more optimistic and forward-looking language reduces how costly it is for lawyers to find a line of attack. Consistent with this idea, Rogers, Buskirk, and Zechman (2011) document that more optimistic disclosure tone is associated with greater litigation risk.[25] Case 1 in the model in Appendix B shows how a reduction in the cost of bringing a suit generates the predictions we see reflected in the main results in Table 2.

We examine this channel by assessingation output coincides with an increase in optimistic and forward-looking corporate disclosure. In Table 8, specification (1), we regress the change in the share of positive words, which we use as a proxy for optimism, in a firm's 10-K from fiscal year end $t-1$ to fiscal year end t on innovation value in year t. To capture positive words, we use the positive financial word dictionary (Fin-Pos) provided on Professor Bill McDonald's Word Lists Page. The results show that the share of positive words increases during years with high

[25]The PSLRA contains a safe harbor provision that exempts some forward-looking statements from being litigated. That provision, and its interpretation, has been heavily debated in courts and among legal scholars. For example, Olazábal (2011) discusses the surrounding legal issues. She also observes that, the safe harbor provision not withstanding, "allegations of false forward-looking statements are also quite standard in today's class action securities fraud pleading." Rogers, Buskirk, and Zechman (2011) also discuss why existing legal rules, in the PSLRA or elsewhere, do not in general imply that firms cannot be sued for optimistic forward-looking statements. In fact, their analysis is a case in point, since it is conducted on a post-PSLRA sample.

Electronic copy available at: https://ssrn.com/abstract=3591201

innovation output, in line with the idea that talking about valuable innovation implies using more optimistic language. In terms of the magnitude, a one-standard-deviation increase in innovation output leads to an increase in the positive word proportion that corresponds to 4% of the mean absolute change.

In specification (2), we examine the use of forward-looking statements. The dependent variable we use is the change in the forward-looking intensity of the firm's Management Discussion & Analysis (MD&A) section in the annual report from year $t-1$ to year t, defined by Muslu, Radhakrishnan, Subramanyam, and Lim (2015) as the number of forward-looking sentences divided by the total number of sentences in the MD&A.[26] Using this measure, we find that the amount of forward-looking statements increases significantly with innovation value. Specifically, a one-standard-deviation increase in innovation output leads to an increase in the fraction of forward-looking statements that corresponds to 3% of the mean absolute change. Note that these numbers may understate the overall effect of changed communication, since much of the communication lawyers take issue with in class action lawsuits comes also from other settings like conference calls and interviews, in which executives may be less careful in the language they use compared with the highly diplomatic, designed-to-be-unassailable language used in SEC filings. We thus conclude that how firms communicate valuable innovation output is a potential channel through which valuable innovation induces more low-quality litigation.

Combined, our results in Section 6.2 provide suggestive evidence that the problem of increased low-quality class action litigation may be closely linked to the changes valuable innovation output induces in corporate behavior. While we believe these results are informative, providing additional evidence on the fundamental drivers of the link between innovation output and litigation risk may be a valuable topic for future research.

7 Potential Implications for the U.S. Economy

Our findings have potentially important implications for understanding how securities class action litigation can affect the competitiveness of the U.S. economy. We discuss some of these implications below.

First, Kogan, Papanikolaou, Seru, and Stoffman (2017) show that valuable innovation output is an important driver of economic growth, and that obtaining a valuable patent is followed by substantial investments in capital and labor. By draining resources, such as financial capital, reputational capital, and managerial time, from innovative firms precisely when these companies want to expand, low-quality class action lawsuits may contribute to economy-wide misallocation

[26] We obtain the forward-looking intensity measure from the data appendix of Muslu, Radhakrishnan, Subramanyam, and Lim (2015) published on the *Management Science* webpage.

of resources.

Second, a standard prediction from optimal contracting models, such as Holmström (1979), Lazear and Rosen (1981), and Holmström (1982), is that optimal incentive provision requires higher rewards for better performance. Our finding that those firms who produce the most valuable new ideas are punished via low-quality class action lawsuits runs counter to that general prescription. Hence, ex-post punishment of firms that generate valuable innovation, in the form a costly lawsuit, may distort innovation incentives for all firms *ex ante*, which may lead to underprovision of innovation in the economy.

We note that, from a managerial perspective, the shareholder-litigation costs incurred by firms with valuable innovation output may be particularly relevant. In case a lawsuit is successful, the manager may lose her job, face legal consequences, and may suffer reputational penalties in the labor market. Managers thus have a particularly great incentive to avoid getting sued in the first place, which, in turn, may lead them to make decisions which are suboptimal from a shareholder value standpoint.

Third, due to the importance of knowledge spillovers (see, e.g., Bloom, Schankerman, and Van Reenen (2013)), low-quality lawsuits, through the disincentives for innovation they entail, may not only affect the growth of innovating firms themselves, but also that of their peers.

Fourth, litigation against innovative firms may create disincentives for these firms to list on public stock markets and thus forego otherwise valuable growth opportunities – an argument in line with both anecdotal and prior academic evidence on class action lawsuits as an impediment to tapping public equity markets (e.g., Zingales (2006)). For example, Robert G. Gilbertson wrote in a July 13, 1995 piece in the Hartfort Currant, titled *"Yes: Bill Would Protect Growing Companies"*:

> *I am chief executive officer of CMX Systems, a small high-tech company in Wallingford that manufactures precision measuring devices for the disk drive and semiconductor industry. By any objective measure, CMX has been ripe for expansion for some time. We grew more than 2,000 percent in the four years from 1990 through 1993, and our sales exceeded $8.6 million in 1993. To continue this extraordinary growth, CMX needed to sell stock to the public in early 1994 to finance a $4 million research-and-development plan. However, we were deterred from this option after watching other small companies get whiplashed by frivolous securities lawsuits.*

Our findings may thus contribute to understanding the well-documented decreasing trend in the number of publicly listed firms in the U.S. (see, for example, Doidge, Karolyi, and Stulz (2017)).

Fifth, as the economy becomes more technology-intensive, the shareholder-litigation costs we identify in this paper may become even more relevant in the future.[27] In addition, by increasing the number of low-quality class action lawsuits, a shift towards technology-driven innovation may also adversely affect the resources judges and courts can expend on dealing with cases of actual wrongdoing.

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 litigation, which we label the "valuable innovation hypothesis." The valuable innovation hypothesis holds that low-quality lawsuits specifically target successful innovators, because such firms are attractive targets for low-quality 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. By contrast, if we follow prior work and focus on innovation input, we find essentially no relation between innovation and low-quality litigation.

Our results contribute new evidence to the important ongoing debate about the efficiency of the U.S. class action litigation system. Our core finding is that low-quality class action lawsuits constitute an economically meaningful cost for firms with valuable innovation output, which

[27] For example, Kogan, Papanikolaou, Seru, and Stoffman (2017) construct an innovation index, which is showing a strong upward trend post World War 2.

has direct implications for the potential real effects of the current class action system. Most immediately, it implies a misallocation of resources by draining money and time from a set of firms which need them the most in order to implement their innovative ideas. In addition, ex-post punishment in the form of low-quality litigation may affect firms' decisions to innovate and/or publicly list *ex ante*. Overall, the evidence in this paper supports the view that the current securities class action system in the U.S. may be an impediment to economic growth and competitiveness. Estimating the full magnitude of these distortions could be a fruitful area for future research.

Our study focuses on innovation output due to its documented importance for economic growth as well as empirical advantages, such as measurement and identification.[28] However, in light of our results on the economic mechanism, 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 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 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.

[28] 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 the innovation setting 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.

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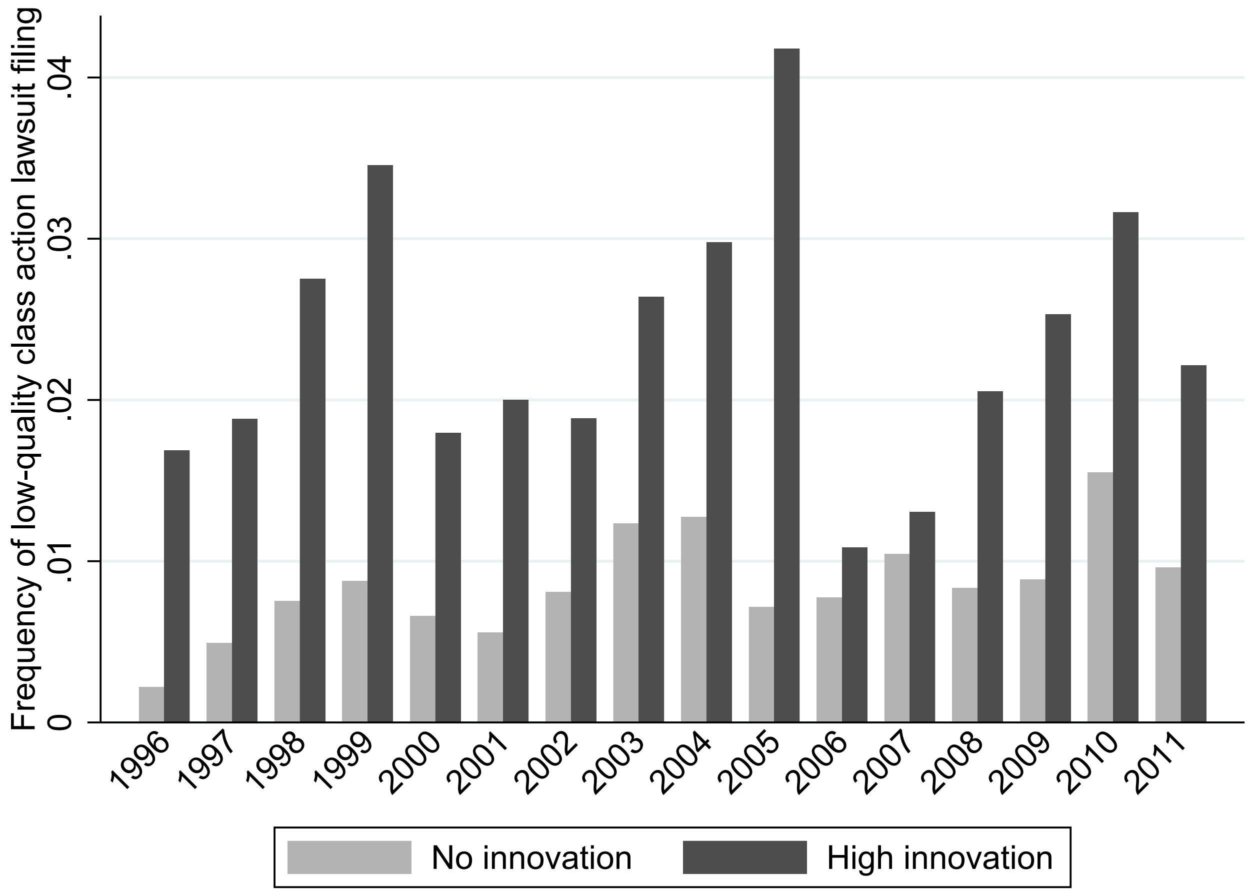

Figure 1: Low-quality securities class action filings by innovation group over time. The figure presents the frequency of low-quality class action lawsuit filings over time for two groups of firms: high innovators and non-innovators. We sort all firms with positive innovation value in the previous calendar 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). Low-quality lawsuits are identified as lawsuits that are eventually dismissed according to the Stanford Securities Class Action Clearinghouse database.

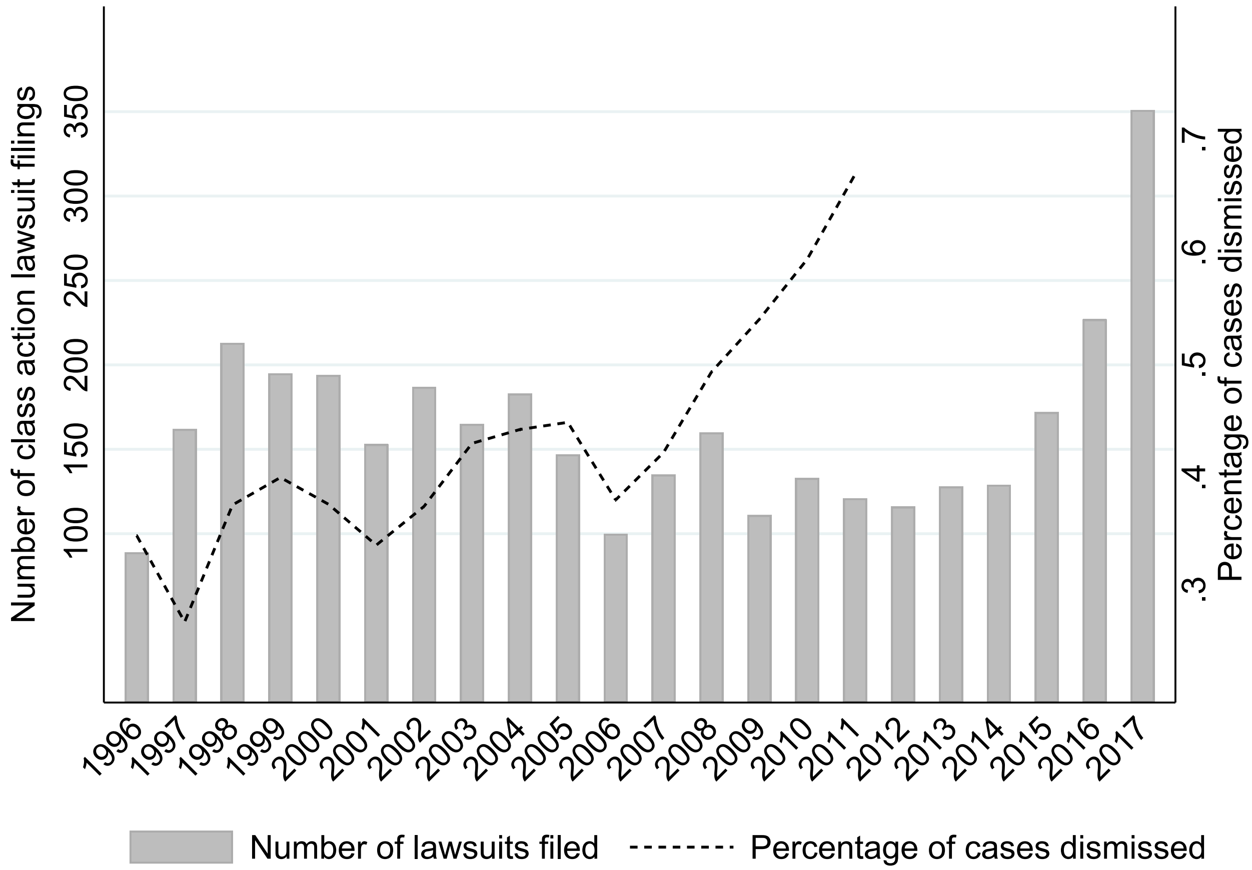

Figure 2: Class action filings and dismissed cases over time.
The figure presents the total number of securities class action lawsuit filed in a given calendar year, and the fraction of these cases which are subsequently dismissed. Securities class action lawsuits, including information on case dismissal, are retrieved from the Stanford Securities Class Action Clearinghouse database. We exclude cases related to IPO underwriter allocation, analyst coverage, and mutual funds.

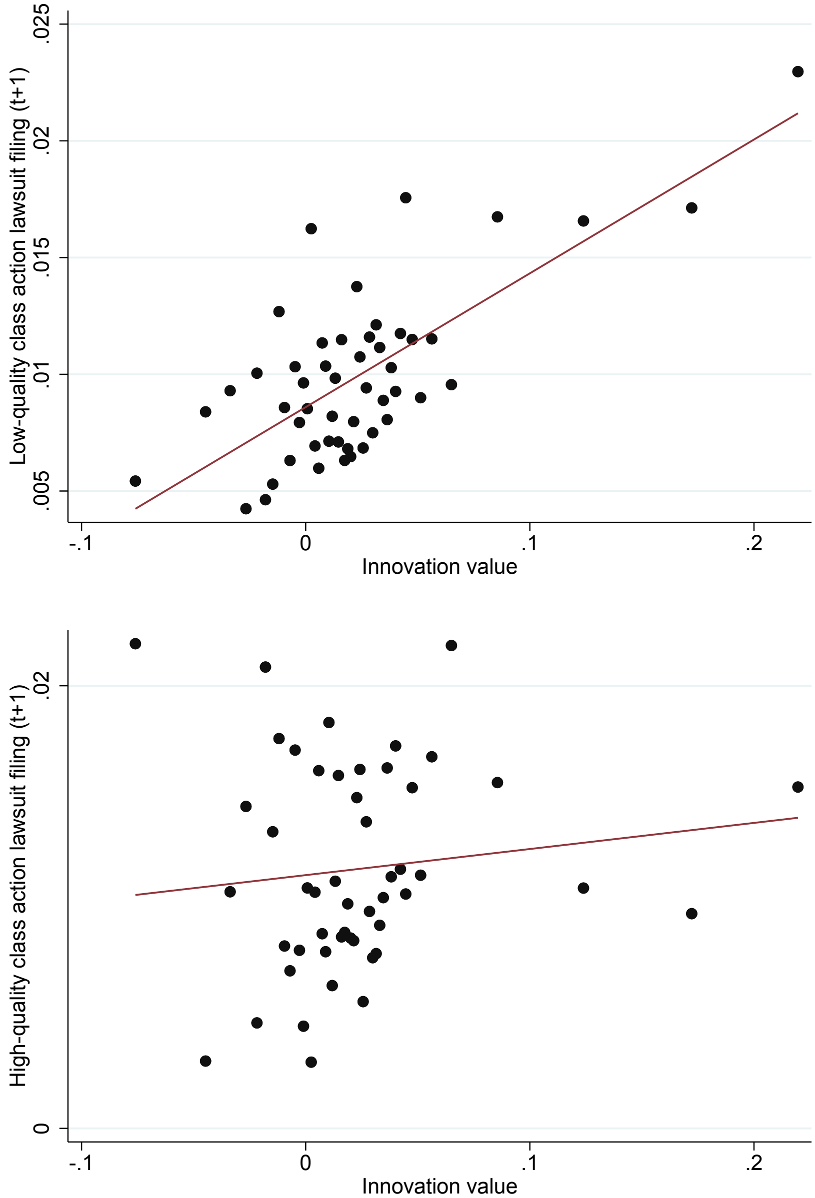

Figure 3: Valuable innovation and next-period class action lawsuit filing.
The figure presents nonparametric binned scatter plots of the relationship between the probability of a class action lawsuit filing in the following year and valuable innovation in the current year. We sort firms' innovation value into 50 equal-sized bins and plot the average frequency of observing a low-quality (upper graph) and high-quality (lower graph) 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.

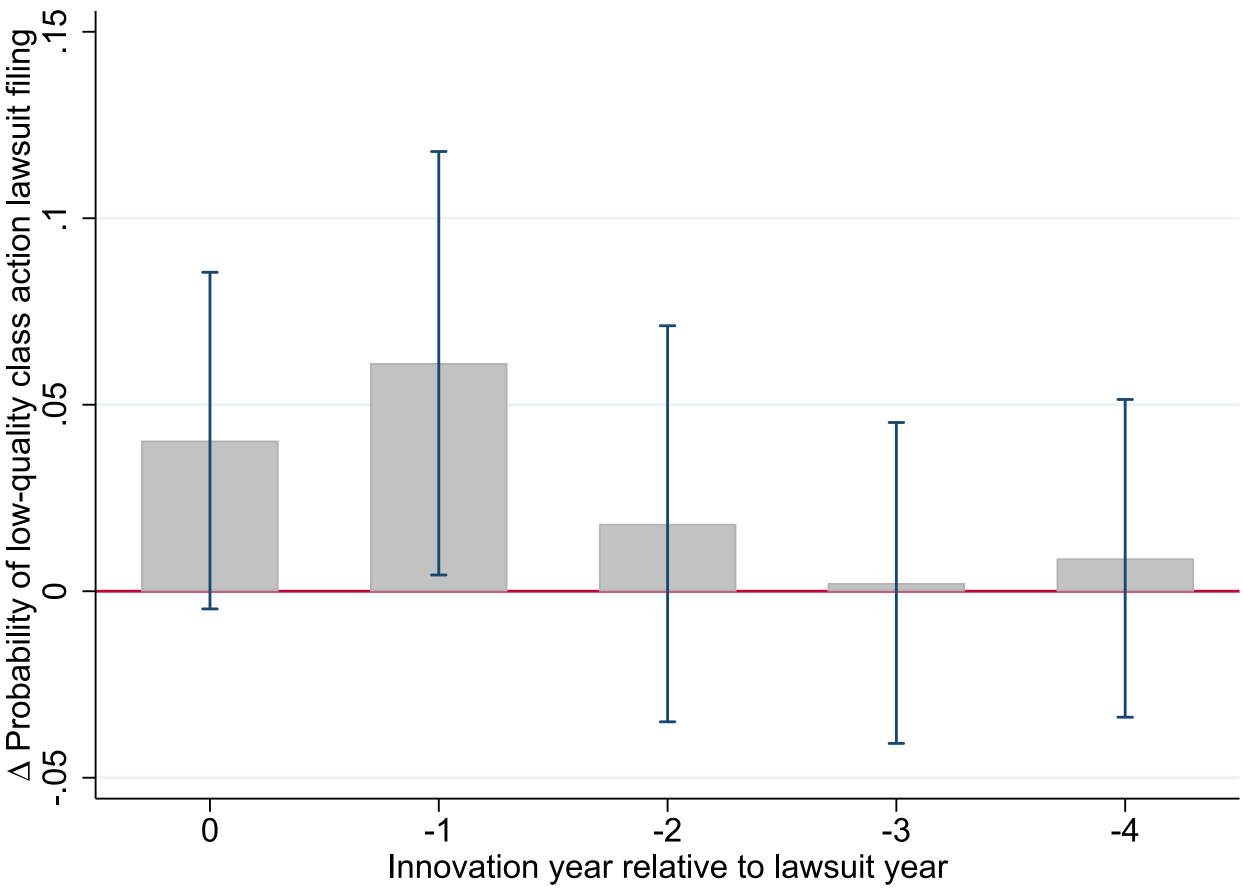

Figure 4: Dynamic effects of valuable innovation on low-quality litigation risk. The figure plots the coefficients and corresponding 95% confidence intervals from a dynamic analysis of the effect of valuable innovation on low-quality litigation risk, based on Equation (2). Innovation value is measured 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.

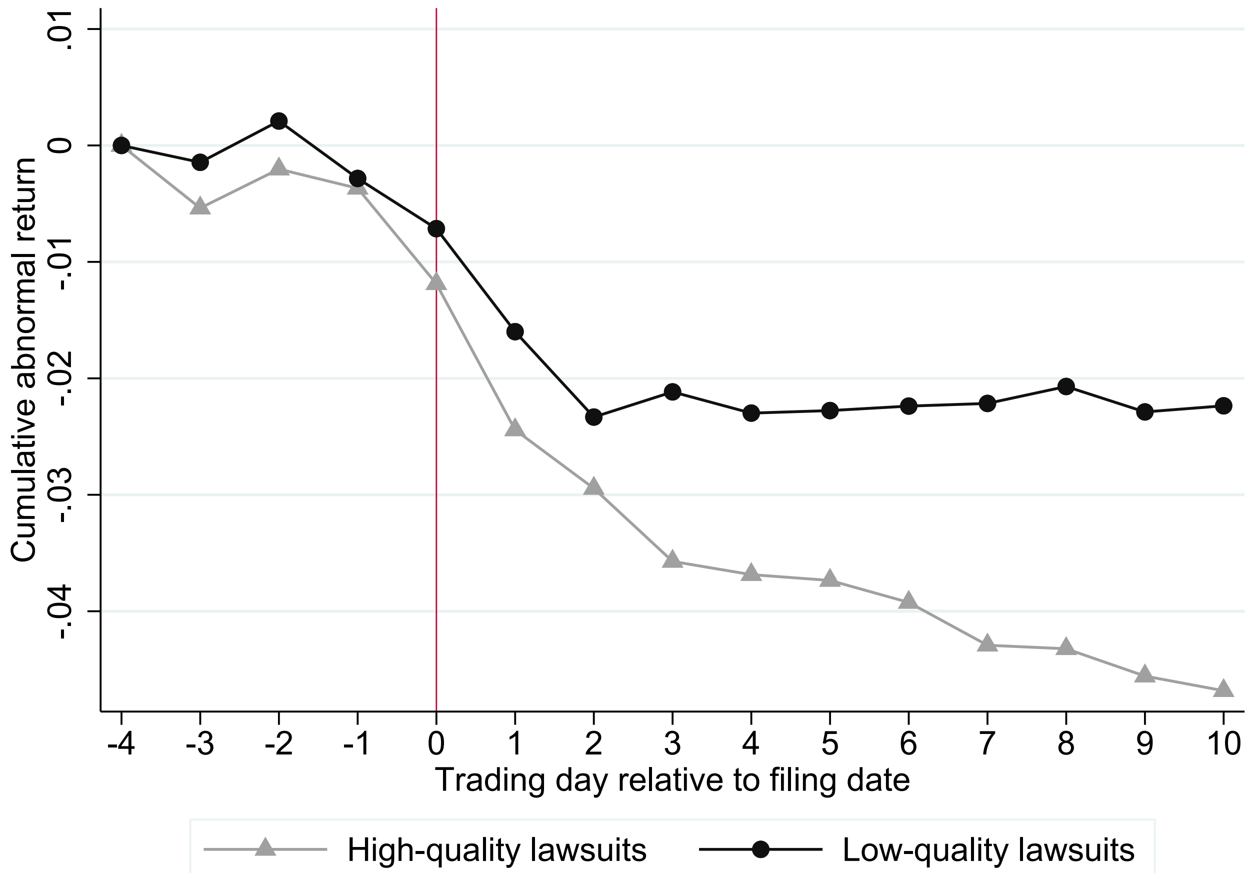

Figure 5: Cumulative abnormal returns around class action lawsuit filings.
The figure shows the cumulative abnormal returns over event days (-3,+10) around the filing of a low-quality versus high-quality lawsuit. Low-quality lawsuits are identified as lawsuits that are eventually dismissed; all other lawsuits are classified as high-quality. Abnormal returns are estimated based on the Fama and French (1993) and Carhart (1997) 4-factor model estimated over days $t = -300$ to $t = -50$. We exclude filing events where the first trading day after the end of the class action period falls into the event window.

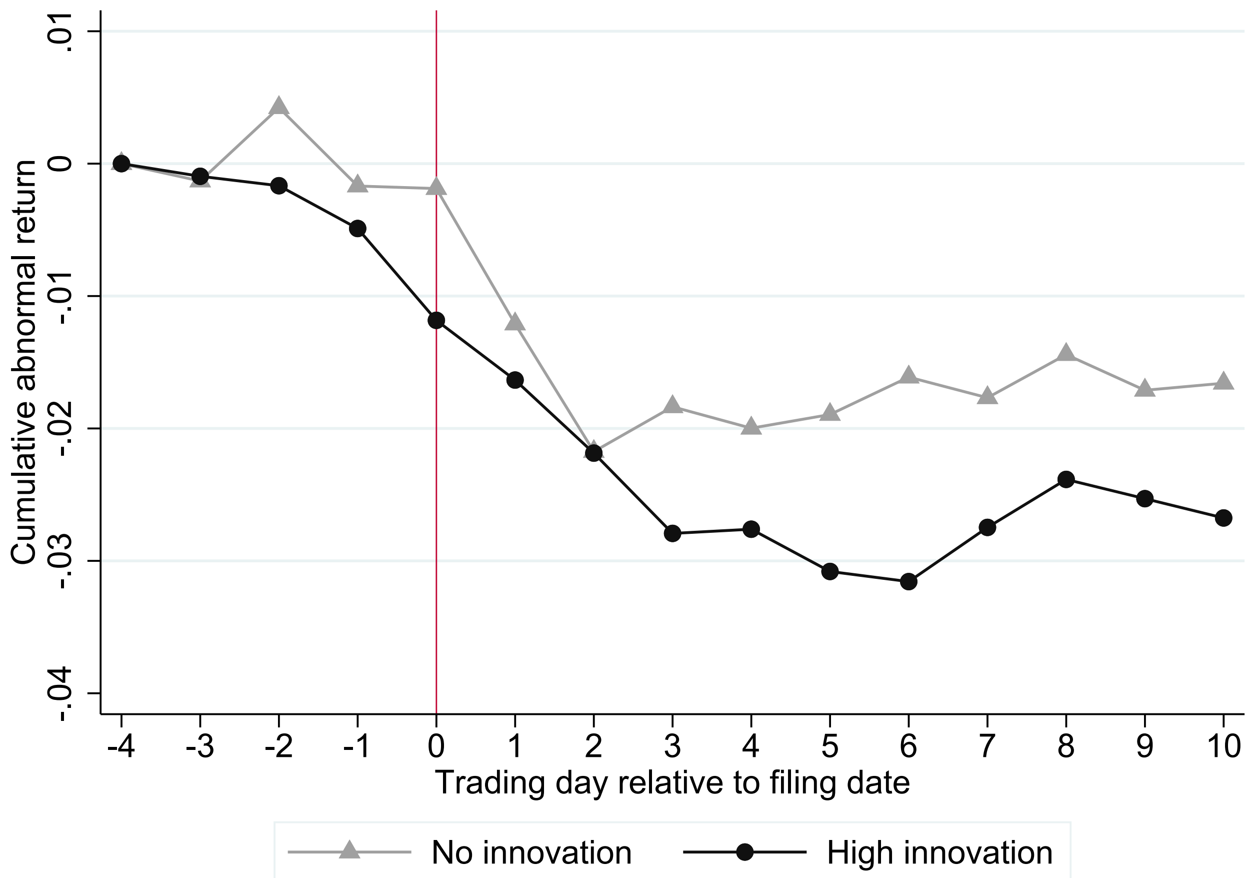

Figure 6: Cumulative abnormal returns around low-quality class action lawsuit filings by innovation group.

The figure 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). Low-quality lawsuits are identified as lawsuits that are eventually dismissed. Abnormal returns are estimated based on the Fama and French (1993) and Carhart (1997) 4-factor model estimated over days $t = -300$ to $t = -50$. We exclude filing events where the end of the class action period falls into the event window.

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. 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)
Tobin's Q$_{t-1}$	0.004	0.002	0.003	0.003	0.001	0.002
	(6.26)	(4.11)	(4.74)	(4.58)	(2.89)	(3.54)
Log assets$_{t-1}$	0.006	0.003	0.003	0.006	0.003	0.003
	(8.34)	(5.46)	(6.48)	(7.87)	(5.61)	(5.64)
Cash$_{t-1}$	0.001	0.001	-0.000	-0.006	-0.002	-0.004
	(0.13)	(0.39)	(-0.12)	(-1.29)	(-0.50)	(-1.20)
Sales growth$_{t-1}$	0.009	0.003	0.005	0.007	0.002	0.004
	(4.87)	(2.78)	(3.88)	(3.74)	(1.85)	(3.18)
Sales growth$_{t-2}$	0.006	0.003	0.004	0.005	0.002	0.003
	(3.94)	(2.33)	(3.18)	(3.08)	(1.78)	(2.53)
IO$_{t-1}$	0.008	0.006	0.003	0.001	0.003	-0.002
	(2.02)	(1.91)	(0.98)	(0.24)	(1.07)	(-0.75)
Stock return$_{t-1}$				0.005	0.002	0.003
				(3.08)	(1.51)	(2.90)
Stock return$_{t-2}$				0.004	0.002	0.002
				(2.13)	(1.50)	(1.56)
Return skewness$_{t-1}$				-0.001	-0.001	-0.000
				(-1.21)	(-1.27)	(-0.53)
Return skewness$_{t-2}$				0.000	0.001	-0.001
				(0.50)	(1.63)	(-1.22)
Return volatility$_{t-1}$				0.006	0.004	0.003
				(1.78)	(1.63)	(0.96)
Return volatility$_{t-2}$				-0.004	-0.000	-0.004
				(-0.98)	(-0.00)	(-1.33)
Turnover$_{t-1}$				0.030	0.021	0.008
				(3.50)	(3.64)	(1.32)
Turnover$_{t-2}$				0.013	-0.003	0.017
				(1.66)	(-0.71)	(2.55)
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: Alternative 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 A.2, 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 4: Robustness

This table presents 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, 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 B, we test alternative definitions of innovation output. High innovation dummy is an indicator equal to one if the firm ranks in the top tercile of firms within a given industry and year, using the Kogan, Papanikolaou, Seru, and Stoffman (2017) measure, conditional on firms with positive innovation value. Next, we scale the continuous innovation measure by lagged market capitalization as opposed to by lagged book assets. We also replace the innovation value measure by 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 as defined by Mukherjee, Singh, and Žaldokas (2017). 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 after excluding calendar years 2000 and 2001.

	Coeff.	*t*-statistic	Econ. Effect	N
Baseline	0.057	(3.50)	33.4%	40,010
Panel A: 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 B: 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 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

Table 5: 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 6: 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$_{t+1}$ (1)	Return skewness$_{t+1}$ (2)	Extreme negative return$_{t+1}$ (3)	Negative earnings surprise$_{t+1}$ (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 7: Valuable Innovation and Firm Growth

This table regresses measures of firm growth on valuable innovation output. 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 book assets. We estimate the following equation:

$$\log(X_{i,t+\tau}) - \log(X_{it}) = \lambda_{jt} + \beta_\tau \mathcal{I}_{it} + \gamma_\tau Z_{it} + \eta_{i,t+\tau}, \tag{4}$$

where τ varies between one and five years, λ_{jt} are 2-digit-SIC industry $\times$ year fixed effects, and Z_{it} is a vector of control variables that includes $\log(X_{it})$, the same variables as the controls in Table 2, specification (5), as well as log values of firm capital, employment, and stock return volatility. As dependent variables, we use capital stock, number of employees, the nominal value of output, and profits, all defined as in Kogan, Papanikolaou, Seru, and Stoffman (2017). t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

		Horizon		
1	2	3	4	5
Panel A: Capital				
0.127	0.263	0.316	0.409	0.497
(3.41)	(4.02)	(3.38)	(3.47)	(3.57)
Panel B: Labor				
0.109	0.214	0.247	0.289	0.332
(3.04)	(3.49)	(2.79)	(2.58)	(2.48)
Panel C: Output				
0.155	0.127	0.206	0.210	0.296
(2.60)	(1.34)	(1.65)	(1.38)	(1.73)
Panel D: Profits				
0.392	0.486	0.628	0.667	0.731
(7.35)	(5.56)	(5.55)	(4.81)	(4.51)

Table 8: Valuable Innovation and Corporate Communication

This table regresses changes in corporate communication on valuable innovation output measured during the same year. In column (1), the dependent variable is the annual change in the average Loughran-McDonald positive word proportion in 10-K filings. In column (2), the dependent variable is the change in the forward-looking intensity of the firm's MD&A disclosure provided by Muslu, Radhakrishnan, Subramanyam, and Lim (2015). Control variables are the same as in Table 2, specification (5), 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.

	Δ Positive word proportion$_t$	Δ Forward-looking intensity$_t$
	(1)	(2)
Innovation value$_t$	0.001	0.017
	(4.34)	(3.41)
Baseline Controls	Yes	Yes
Additional Controls	Yes	Yes
Industry × year f.e.	Yes	Yes
R^2	0.185	0.413
N	28,029	21,466

APPENDIX

A 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. 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

B A Simple Model

In this section, we present a simple model to motivate our main empirical predictions. The model is stylized, but we nevertheless believe it captures central features relevant to understanding class action lawsuits in our setting.

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 $t = 0$, the 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, they have 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 $t = 2$.[29] 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 of not being dismissed by a judge upon the motion to dismiss.[30] 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. 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

[29]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.

[30]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.

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 probability that the defendant loses in a trial. This may be due to a judicial mistake or because additional material facts, not anticipated by anyone before, could 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).

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 $(1 - p_d(k))^2 > c$. Thus, in our model, lawyers have an incentive to file some meritless suits because they are positive expected value bets.[31]

Note that we can assume that, upon filing, the firm incurs a loss in its market capitalization because of reputation and other costs, consistent with our empirical results. But, since these costs are "sunk" once the case is filed, they will not matter for what follows.

Case 1 (innovation affects filing costs for the plaintiff): Suppose innovation makes it easier for the law firm to attack a firm, in the sense that innovation is associated with a lower cost of bringing the suit. One example could be that innovative firms issue more forward-looking statements, which are by nature more speculative and debatable and offer an opening for lawyers to craft a meritless suit. In our model, this would lower the lawyer's cost c associated with suing high innovation firms – for example, because the law firm needs to spend less effort and resources in setting up the legal strategy, or because the concern about potential negative repercussions on the law firm's reputation is weaker when the facts of the case are more opaque.

[31] At this point of the model, 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 in Case 2 below.

Prediction 1: Across all K firms, increasing innovation makes is 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 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 $k_{\text{new}} < k^*$.[32] 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 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

$$\Delta \Pr(\text{filed}) = \frac{N}{K} > 0. \tag{5}$$

□

Prediction 2: Across all K firms, the chance of being subject to a lawsuit that is dismissed increases as innovation increases.

Proof: Out of the N additional cases that are filed when innovation 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

$$\overline{p_d^{\text{new}}} = \frac{1}{N} \sum_{k=k_{\text{new}}}^{k^*} p_d(k). \tag{6}$$

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

$$\Delta \Pr(\text{filed\&dismissed}) = \frac{\overline{p_d^{\text{new}}}N}{K} > 0. \tag{7}$$

□

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

Proof: Following the logic of the proof for prediction 2, 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

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

and not dismissed across all K firms increases by

$$\Delta \Pr(\text{filed\&non-dismissed}) = \frac{(1-\overline{p_d^{\text{new}}})N}{K} > 0. \tag{8}$$

$\square$

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:

$$\frac{\overline{p_d^{\text{new}}}N/K}{\overline{p_d^{\text{old}}}N_{\text{old}}/K}, \tag{9}$$

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

$$\frac{(1-\overline{p_d^{\text{new}}})N/K}{(1-\overline{p_d^{\text{old}}})N_{\text{old}}/K}. \tag{10}$$

We can derive the following prediction:

Prediction 4: 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 (consistent with the standardized difference between columns (5) and (6) in Table 2 of our baseline regression being positive).

Proof:

$$\frac{\overline{p_d^{\text{new}}}N}{\overline{p_d^{\text{old}}}N_{\text{old}}} > \frac{(1-\overline{p_d^{\text{new}}})N}{(1-\overline{p_d^{\text{old}}})N_{\text{old}}} \tag{11}$$

can be rewritten as

$$\frac{\overline{p_d^{\text{new}}}}{(1-\overline{p_d^{\text{new}}})} > \frac{\overline{p_d^{\text{old}}}}{(1-\overline{p_d^{\text{old}}})}, \tag{12}$$

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.

$\square$

We can also compute the ratio of the increase in dismissed and non-dismissed cases as:

$$\frac{\Delta \Pr(\text{filed\&dismissed})}{\Delta \Pr(\text{filed\&non-dismissed})} = \frac{\overline{p_d^{\text{new}}}}{(1-\overline{p_d^{\text{new}}})}. \tag{13}$$

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 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 (13) implies that $\overline{p_d^{\text{new}}}$ is around 83%.

Case 2 (innovation affects litigation costs for the defendant): Suppose 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 if innovation is high of $C_I > 0$. This formulation captures that opportunity cost and reputation concerns may be more of a concern for successful innovators, since these firms are about to invest in capital and labor, and since they are about to bring new products to the market.

Conditional on a non-dismissed case, an innovative firm now 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

$$(1 - p_d(k))(1 - p_d(k) + \gamma C_I) > c. \tag{14}$$

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

Prediction 1: Across all K firms, increasing innovation makes is 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

$$\Delta \Pr(\text{filed}) = \frac{N}{K} > 0. \tag{15}$$

□

Prediction 2: as above.

Proof: as above.

Prediction 3: as above.

Proof: as above.

Prediction 4: as above.

Proof: as above.

C Predicting Lawsuit Dismissals

Table A.2: Predicting Lawsuit Dismissals

The table reports results from regressing lawsuit dismissal on ex-ante lawsuit characteristics. Disclosure losses are computed as the dollar-value change in the defendant firm's market capitalization between the trading day immediately preceding the end of the class period and the trading day immediately following the end of the class period. Filing gap is the logarithm of one plus the difference between the lawsuit filing date and the end of the class action period. Alleged fraud duration is the length of the class action period. The Securities Acts claims, type of allegations, and trends are obtained directly from the SCAC database. Lawyer market share is computed as the fraction of all non-dismissed securities class action lawsuits filed by a given law firm during a given calendar year, averaged across three calendar years preceding the year of the lawsuit filing. Institutional investor is an indicator equal to one if one of the plaintiffs is an institutional investor. *t*-statistics, reported in parentheses, are based on standard errors that allow for clustering at the calendar month of the filing date.

	Dismissed	
	(1)	(2)
Disclosure losses	0.020	0.018
	(2.55)	(2.21)
Lawyer market share	-2.987	-2.461
	(-3.22)	(-2.35)
Filing gap	0.023	0.024
	(2.73)	(2.69)
Fraud duration	-0.040	-0.037
	(-2.62)	(-2.30)
Institutional investor	-0.004	0.010
	(-0.13)	(0.26)
Allegations – Failed disclosure	0.005	-0.013
	(0.07)	(-0.18)
Allegations – GAAP	-0.105	-0.110
	(-3.44)	(-3.30)
Allegations – Insider trading	0.099	0.107
	(0.74)	(0.74)
Allegations – Irregularity	-0.094	-0.069
	(-1.87)	(-1.27)
Allegations – M&A	0.024	-0.013
	(0.22)	(-0.11)

Continued on next page

	Dismissed	
	(1)	(2)
Allegations – Misrepresentation	-0.058	-0.050
	(-0.88)	(-0.69)
Allegations – Product liability	-0.147	-0.145
	(-1.08)	(-1.06)
Claims – 1934 Sec 10b	-0.028	-0.017
	(-0.37)	(-0.23)
Claims – 1934 Sec 14a	0.035	0.065
	(0.52)	(0.88)
Claims – 1934 Sec 20a	-0.093	-0.116
	(-1.49)	(-1.91)
Claims – 1934 Sec 20a1	-0.071	-0.067
	(-1.12)	(-1.02)
Claims – 1933 Sec 11	-0.295	-0.307
	(-4.60)	(-4.25)
Claims – 1933 Sec 12a	0.026	0.031
	(0.38)	(0.43)
Claims – 1933 Sec 15	0.053	0.059
	(0.71)	(0.73)
Claims – Non-federal	0.120	0.113
	(2.04)	(1.80)
Trend classic	0.054	-0.014
	(0.34)	(-0.09)
Trend credit crisis	0.132	0.056
	(0.81)	(0.33)
Trend option backdating	-0.135	-0.256
	(-0.75)	(-1.36)
District f.e.	No	Yes
R^2	0.101	0.165
N	1,195	1,195

D Instrumental Variable Regressions

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., Bloom, Schankerman, and Van Reenen (2013), Kogan, Papanikolaou, Seru, and Stoffman (2017), Matray and Hombert (2018)). 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.

It may be tempting to think that an instrument based on R&D tax credits should not generate a significant second-stage result, since innovation input is not significantly related to low-quality litigation in Table 2. However, it is important to note that in Table 2, we simultaneously control for innovation output. The results therefore imply that innovation input does not have any *incremental* effect on low-quality litigation over and above the effect of innovation output. But, in order to generate a valuable patent, a firm must have previously invested in R&D, and, as a result, exogenous variation in R&D inputs should lead to changes in the future aggregate value of innovation output. It is this idea that innovation input is a necessary condition to generate valuable innovation output that our first instrumental variable regression exploits.

To construct the instrument, we use estimates of the user cost of R&D capital provided by Wilson (2009) and match them to the geographical distribution of the firm's R&D activity. To estimate the geographical distribution of R&D activity, we follow Bloom, Schankerman, and Van Reenen (2013) and use the 10-year moving average share of the firm's inventors located in each state, using the PatEx database to retrieve inventor locations. We then compute the weighted average change in the R&D user cost over the years $t-3$, $t-4$, and $t-5$ relative to the innovation output year, in order to capture changes in the tax incentives prevailing prior to the patent filing (which on average occurs three years prior to the grant).

To be a valid instrument, changes in the user cost of R&D must satisfy the relevance and exclusion conditions. The relevance condition requires that the instrument is related to our variable of innovation value, $\mathcal{I}_{it}$, in the first-stage regression. Since the purpose of R&D tax credits is to promote innovation, and since the evidence in Wilson (2009) and the related literature finds R&D tax credit are successful in that regard, the instrument satisfies the relevance condition. The exclusion restriction requires that the instrument affects the dependent variable only via its effect on the independent variable to be instrumented. The existing literature above suggests that R&D tax credits satisfy this condition due to a large degree of randomness regarding the introduction and level of R&D tax credits on the state level (see, for example, Bloom, Schankerman, and Van Reenen (2013)).[33]

[33] One may worry about state-level economic conditions being correlated with changes in R&D tax credits.

The second instrument exploits the patent grant process at the USPTO and is based on the leniency of the USPTO patent examiners assigned to outstanding patent applications of the firm (Sampat and Williams (2019)). 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. Sampat and Williams (2019) argue that the overall leniency of the assigned patent examiner is a valid instrument for the ultimate grant outcome. First, regarding the relevance criterion, patent examiners have a substantial amount of discretion when handling patent applications, and hence, likely have significant influence on the grant decision. Second, regarding the exclusion restriction, interviews with current and former USPTO examiners have indicated that the assignment process of examiners to new patent applications is effectively random within a given art unit and filing year (Lemley and Sampat (2012)). Sampat and Williams (2019) provide evidence supporting this conditional random assignment assumption by showing that patent applications assigned to "lenient" and "strict" examiners do not differ on observable characteristics at the time of patent application. Further strengthening the random assignment argument, A.4 shows that average examiner leniency is uncorrelated with predicted innovation value, where innovation value is predicted as a function of the firm-level control variables in Table 2.

We construct our measure of average patent examiner leniency as follows. For each patent application, we compute examiner leniency, following Sampat and Williams (2019), as the average approval rate using all other applications evaluated by the same examiner. We then regress this measure on Art Unit $\times$ year fixed effects in order to capture only variation within the same Art Unit and application year, and average the residuals across all outstanding patent applications for a given firm at the end of each calendar year. We add the number of pending applications per firm as an additional control variable.

Table A.3 presents the results of our two-stage least squares estimates. Panel A shows the first-stage regression. Consistent with the existing literature, we find a strong negative relationship between the user cost of R&D capital and valuable innovation, and a positive relationship between examiner leniency and valuable innovation.[34] Panel B presents results from the second stage. For both instruments, we find that instrumented innovation value continues to be a strong predictor of low-quality class action lawsuits.

The IV point estimates imply a larger effect of valuable innovation on low-quality litigation

If local economic conditions are also correlated with shareholders' propensity to file a meritless lawsuit, this may bias our inference. Alleviating these concerns, Bloom, Schankerman, and Van Reenen (2013) search for evidence of a correlation of changes in tax credits with state-level economic conditions, but do not find such evidence. In addition, since we will have two instruments, we can estimate a specification using both instruments simultaneously and use the Hansen J-test to test the exclusion restriction. We do not reject the null hypothesis that our two instruments are valid.

[34] The F-statistics suggest these are reasonably strong instruments.

risk than the OLS estimates. A one-standard-deviation increase in valuable innovation leads to a 2.5 (=0.422×0.060) and 5.6 (=0.940×0.060) percentage point increase in the likelihood of a low-quality lawsuit being filed against the firm, respectively.

There could be several potential explanations for this difference in economic magnitudes. First, measurement error in our innovation value variable will lead to an attenuation of the OLS coefficient, but not of the IV coefficient. Our measure of innovation value, being based on stock market reactions, is potentially subject to measurement error. In particular, if the stock market is able to anticipate the grant of particularly valuable patents, the KPSS measure will be downward biased. Second, the decision to file a lawsuit may be influenced by unobservable firm characteristics that are also correlated with innovation value. For example, if better-run firms are both, more likely to produce valuable patents and less likely to be subject to securities class action lawsuits, our OLS coefficients will be biased downwards.

We conclude from the IV regressions that they confirm our main OLS result: valuable innovation has an economically sizable effect on a firm's likelihood to be the target of a low-quality securities class action lawsuit.

Table A.3: Instrumental Variable Regressions

This table shows results from instrumental variable regressions. Panel A reports the first-stage results and Panel B the second stage. We use two instrumental variables. The first instrument is the change in the firm's user cost of R&D capital, measured during years (–5,–3) prior to the innovation year. We obtain state-level user cost of R&D capital from Wilson (2009), and use the location of the firm's inventors to estimate the geographical distribution of R&D activity over the previous ten calendar years. The second instrument is the average leniency of the USPTO patent examiners assigned to the outstanding patent applications of the firm at the end of the year prior to valuable innovation. We compute examiner leniency for each application as the average approval rate for all other applications processed by the same examiner over her career (excluding the application itself), after residualizing on art unit by application-year fixed effects. Control variables are the same as in Table 2, specification (5). In columns (3) and (4), we also control for the log of the number of outstanding patent applications. Both instrumental variables and sorted into deciles within industry and year. *t*-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

Panel A: First stage

	Innovation value$_t$			
	(1)	(2)	(3)	(4)
Δ R&D user cost$_{(t-5,t-3)}$	-0.003	-0.002		
	(-10.31)	(-6.77)		
Examiner leniency$_{t-1}$			0.001	0.001
			(2.95)	(3.17)
Baseline Controls	No	Yes	No	Yes
Additional Controls	No	Yes	No	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes
N	21,570	17,184	25,070	19,161
F-test statistic	106.23	45.84	8.72	10.03

Panel B: Second stage

	Low-quality class action lawsuit filing$_{t+1}$			
	(1)	(2)	(3)	(4)
Innovation value$_t$	0.307	0.422	0.938	0.940
	(3.31)	(2.20)	(1.94)	(1.89)
Baseline Controls	No	Yes	No	Yes
Additional Controls	No	Yes	No	Yes
Industry × year f.e.	Yes	Yes	Yes	Yes
N	21,570	17,184	25,070	19,161

Table A.4: Predicted Innovation Value and Patent Examiner Leniency

The table reports results from regressing predicted innovation value on patent examiner leniency. In columns (1) and (2), we predict innovation value as a function of the control variables in Table 2, specifications (2) and (5), respectively. Innovation value is measured as the economic value of patents granted to the firm, as provided by Kogan, Papanikolaou, Seru, and Stoffman (2017). We control for the number of pending applications in both specifications. *t*-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

	Predicted innovation value$_t$	
	(1)	(2)
Examiner leniency$_{t-1}$	-0.000	-0.000
	(-0.82)	(-0.67)
Industry × year f.e.	Yes	Yes
R^2	0.26	0.27
N	22,286	20,710

E Long-run Stock Returns Post Lawsuit Filing

This section complements the results on the costs of low-quality and high-quality class action lawsuit filings presented in Section 5.6 in the main paper, by studying long-term abnormal stock returns in the months following the lawsuit filing. We analyze long–run returns using a calendar-time portfolio approach (Fama (1998)) combined with the Fama and French (1993) and Carhart (1997) four-factor model.

Specifically, we form an equally weighted long-only portfolio using all sample firms that have been a target of a low-quality (high-quality) lawsuit filing in the previous 2, 4, 6, or 8 calendar months. We estimate abnormal returns using both ordinary least squares (OLS) regressions as well as weighted least squares (WLS) regressions, where weights are proportional to the number of stocks in the portfolio in a given calendar month.

Table A.5 presents the average monthly abnormal returns on the portfolio. For low-quality lawsuits, abnormal returns in the 8 months following the lawsuit filing are always insignificant, with a negative sign. These patterns suggest that the initial stock-value losses incurred by firms that are targets of a low-quality lawsuit filing do not reverse during the first 8 months following the lawsuit filing and are therefore quite long-lasting.

In contrast, the abnormal returns of firms that are target of a high-quality lawsuit filing are always negative and almost always statistically significant. Over the first 8 months following the lawsuit filing, stocks underperform the passive portfolio by a risk-adjusted 7.1% ($= 0.893 \times 8$). This suggests that high-quality lawsuit filings are followed by further revelation of information about the corporate misconduct, consistent with Karpoff, Koester, Lee, and Martin (2017).

Table A.5: Long-Run Stock Returns Post Lawsuit Filing

This table reports results from a calendar-time portfolio approach. At the end of each month we form a long-only portfolio using all firms that were target of a high-quality or low-quality lawsuit filing in the previous 2 (4, 6, 8) calendar months. We then calculate the average monthly abnormal return of this portfolio using the Fama and French (1993) and Carhart (1997) four-factor model. We consider two estimation approaches: ordinary least squares (OLS) regressions as well as weighted least squares (WLS) regressions, where weights are proportional to the number of stocks in the long portfolio in a given calendar month. Panel A (B) computes abnormal returns for the portfolio that consists of firms that were target of a low-quality (high-quality) lawsuit filing, respectively.

Panel A: Long-run Stock Returns after Low-quality Lawsuits

	t=2	t=4	t=6	t=8
OLS	-0.455	-0.315	-0.320	-0.200
	(-0.57)	(-0.64)	(-0.82)	(-0.60)
WLS	-0.208	-0.387	-0.215	-0.178
	(-0.31)	(-0.83)	(-0.58)	(-0.56)

Panel B: Long-run Stock Returns after High-quality Lawsuits

	t=2	t=4	t=6	t=8
OLS	-0.221	-1.360	-1.280	-0.893
	(-0.29)	(-2.51)	(-2.95)	(-2.31)
WLS	-1.090	-1.100	-1.240	-0.841
	(-1.59)	(-2.47)	(-3.33)	(-2.52)

F Do Successful Innovators Commit More Fraud?

In this section, we would like to zoom in on high-quality lawsuits and investigate whether valuable innovation output may link positively to the propensity to commit fraud. This question is relevant, even though valuable innovation showed no significant link to high-quality lawsuits in our baseline test in Table 2. The reason is that lawsuits can only be brought for true frauds if they are detected, which implies that more fraud can be committed even if we do not see an increase in high-quality lawsuits. In our setting, a lower detection probability, perhaps because innovative firms are more opaque for outsiders, may offset a greater propensity to commit fraud among successful innovators. Separating fraud commission from fraud detection is the aim of this section.

Separating fraud commission from fraud detection is a long-standing challenge for studies of corporate fraud. We follow the standard approach in the literature to deal with the problem of partial observability and estimate a Poirier (1980) bivariate probit model. At the heart of this model is the idea that fraud commission and fraud detection can be separated if a researcher is willing to commit to a specific way of modelling the two as separate, but related equations. Our exposition in this section largely follows Wang, Winton, and Yu (2010). Specifically, we denote F^*_{it} as the latent variable determining firm i's decision to commit fraud in year t and L^*_{it} as the latent variable that governs the subsequent detection of a possible fraud, respectively:

$$F^*_{it} = \beta'_F X_{F,it} + \eta_{it} \tag{16}$$

$$L^*_{it} = \beta'_L X_{L,it} + \epsilon_{it}, \tag{17}$$

where $X_{F,it}$ and $X_{L,it}$ are vectors of observable variables determining fraud commission and detection, respectively. A key assumption of Poirier (1980)'s model is that η_{it} and ϵ_{it} are distributed bivariate standard normal; their correlation is denoted by ρ. Fraud is committed ($F_{it} = 1$) if $F^*_{it} > 0$, and it is detected ($L_{it} = 1$) if $L^*_{it} > 0$. The realizations of F_{it} and L_{it} are not directly observed; instead, we observe the product $Z_{it} = F_{it}L_{it}$.[35] Let Φ denote the bivariate standard normal cumulative distribution function. Then the model for the observable variable Z_{it} is given by:

$$\mathrm{P}(Z_{it} = 1) = \Phi(\beta'_F X_{F,it}, \beta'_L X_{L,it}, \rho) \tag{18}$$

$$\mathrm{P}(Z_{it} = 0) = 1 - \Phi(\beta'_F X_{F,it}, \beta'_L X_{L,it}, \rho) \tag{19}$$

[35]The dependent variable is thus an indicator equal to one if the firms starts to engage in fraud in a given calendar year, and zero otherwise. We use the start of the class action period as opposed to the year of the lawsuit filing to identify fraud starts.

and the log-likelihood of the model by

$$\mathcal{L}(\beta_F, \beta_L, \rho) = \sum \log(\mathrm{P}(Z_{it} = 1)) + \sum \log(\mathrm{P}(Z_{it} = 0)). \tag{20}$$

The above model is fully identified and can be estimated using the maximum-likelihood method under two conditions. First, $X_{F,it}$ and $X_{L,it}$ must not contain exactly the same variables. That is, the researcher needs to identify variables which affect only fraud detection but not fraud commission, or vice versa. Second, the explanatory variables need to exhibit sufficient variation.

We implement the model as follows. First, we follow Dyck, Morse, and Zingales (2014) and use option grants as well as the percentage of incentive pay as instruments in the fraud commission equation.[36] We include a standard set of observable control variables proposed by the existing fraud literature. Specifically, we control for firm characteristics (Tobin's Q, the log of total book assets, cash holdings (defined as cash over lagged assets), leverage, return on assets, stock return), and proxies for monitoring intensity by outsiders (institutional ownership, analyst coverage).

Because the second requirement for bivariate probits – explanatory variables need to exhibit sufficient variation – effectively makes it impossible to include industry $\times$ year fixed effects, we include year fixed effects and control for industry-level heterogeneity as in Dyck, Morse, and Zingales (2014) by adding indicators for Qui-Tam industries and regulated industries as additional controls. Columns (1) and (2) in Table A.6 present the results. They indicate that valuable innovation does not significantly affect a firm's propensity to commit fraud (column (1)), or the propensity to be litigated conditional on committing fraud (column (2)).

In the next two specifications, we add variables that exclusively affect fraud detection. Following Wang, Winton, and Yu (2010), we use abnormal stock return and abnormal turnover in the detection equation. Both variables are measured over the two calendar years *after* the year of fraud commission. We compute abnormal versions of returns and turnover by absorbing industry $\times$ year effects. Columns (3) and (4) show again that valuable innovation does not significantly affect a firm's propensity to commit fraud. If anything, the signs of the coefficients go in the opposite direction: valuable innovation tends to decrease fraud commission and increases fraud detection, although not in a statistically significant way.

The results on R&D suggest that firms which invest heavily in R&D are more likely to commit fraud. This is consistent with the findings by Wang (2013), who argues that R&D-intensive firms

[36]Previous work has documented that managers who have more stock options are more likely to manipulate accounting numbers, which may indicate a generally greater willingness of managers with high-powered incentives to engage in fraud and be sued (e.g., Burns and Kedia (2006), Bergstresser and Philippon (2006)). Because measures of executive pay are available only for a subset of firms, and because restricting our sample to only firms with available pay data would severely reduce the number of cases we can analyze, we include dummy variables indicating missing executive pay variables, and thus, effectively, estimate an average effect for these firms.

are more opaque and thus have more possibilities to commit fraud.[37]

[37] However, our results differ from Wang (2013) in that fraud detection is not significantly related to R&D.

Table A.6: Bivariate Probit Model

This table presents results from a bivariate probit model with partial observability. The dependent variable is a dummy variable equal to one if the firm starts to commit fraud in the next calendar year, and zero otherwise. Frauds are identified as class action lawsuits that do not get dismissed and do not settle for less than \$3m. The estimation of fraud propensity is indicated by $F = 1$, and the estimation of lawsuit filing (or "detection") likelihood is indicated by $L = 1$. Incentive pay refers to the average of the ratio of restricted stock grants divided by total compensation across executives for a firm-year. Log option value is measured as the log of the sum of the in-the-money exercisable options for all executives. Abnormal stock returns and stock turnover are estimated after averaging the raw measures over the two calendar years following the year where fraud commission is measured, and regressing them on industry-year fixed effects. Control variables are Tobin's Q, the log of total assets, cash holdings, leverage, ROA, past stock return, institutional ownership, log of number of analysts following, as well as year dummies and indicators for Qui Tam and regulated industries, defined as in Dyck, Morse, and Zingales (2014). t-statistics, reported in parentheses, are based on standard errors that allow for clustering at the firm level.

	(1) F=1	(2) L=1	(3) F=1	(4) L=1
Innovation value	-0.223	0.457	-0.305	0.764
	(-0.47)	(1.06)	(-0.57)	(0.88)
R&D	0.748	0.227	1.049	-0.481
	(2.02)	(0.41)	(2.47)	(-0.70)
Log option value	0.096		0.070	
	(2.14)		(1.39)	
Incentive pay	-0.003		0.266	
	(-0.01)		(1.15)	
Abnormal stock return				-5.484
				(-2.32)
Abnormal turnover				0.015
				(2.91)
Controls	Yes	Yes	Yes	Yes
Year f.e.	Yes	Yes	Yes	Yes
N	32,858	32,858	29,939	29,939

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