Friend or Foe: How Social Movements Impact Firm Innovation

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Abstract: We investigate the impact social movements have on firm-level innovation through private politics. We distinguish between contentious private politics, or contentious targeting of firms by activists, and cooperative private politics, when activists engage firms in formal collaborations. Combining insights from behavioral theory and social movement theory, we theorize that both contentious and cooperative private politics impact innovation but in different ways. Contentious private politics is a more effective catalyst for innovation quantity because it threatens material or symbolic damage, and in so doing, promotes risk-taking by decision makers. In comparison, cooperative private politics which triggers gain framing of problems leads to less innovation overall, but by providing firms access to new knowledge and triggering distant search, is more effective at driving novel innovations. We test our arguments in a matched sample of firms contentiously targeted, and with activist collaborations, on climate change issues, and firms that were not targets of private politics on those issues but had otherwise similar environmental performance and relationships with climate change and other environmental movements. We find contentiously targeted firms increase the number of patent applications on the issue advocated by the movement by 7% the following year, while firms that collaborate with activists have 12% greater novel patents. Our study contributes to stakeholder perspectives on innovation by theorizing how social movements catalyze firm-level innovation. To research on movements and markets, this study offers the first comparative analysis of the impacts of contentious and cooperative private politics on firm outcomes.

Keywords: social movements, innovation, private politics, cross-sector collaboration, climate change

INTRODUCTION

Innovation is not only a key determinant of the competitiveness of firms (Greve, 2003; Polidoro & Theeke, 2011) and nations (Porter, 1990), but is increasingly seen as a means to tackle societal grand challenges such as climate change (George, Howard-Grenville, Joshi, & Tihanyi, 2016). However, an encumbrance to innovations that benefit society is their returns are not fully appropriated by firms due to their associated positive externalities (King, 2007). This can lead to persistent underinvestment by the private sector in innovations that create public goods (e.g., reductions greenhouse gas emissions). Thus, alongside supply-side explanations of innovation which prevail in strategy research (Di Stefano, Gambardella, & Verona, 2012), scholars emphasize the necessity for external inducements (i.e., demand-side) to spur innovations with societal benefits (Berrone, Fosfuri, Gelabert, & Gomez-Mejia, 2013). For example, stricter greenhouse gas regulations, government subsidies for climate-friendly technologies, and changing customer preferences, can drive green innovation (Costantini, Crespi, & Palma, 2017).

While governments and customers clearly play a role in inducing innovation with societal benefits, there is another set of stakeholders equally active in seeking improvements in firms' social and environmental performance: social movement activists. Activists' direct engagement of firms, referred to as private politics (Baron, 2012), is a key driver of change in organizations and markets (King & Pearce, 2010). Social movements can help entrepreneurs create new products and markets (Lounsbury, Ventresca, & Hirsch, 2003), and spur practice change in incumbent firms (Briscoe, Gupta, & Anner, 2015). In spite of growing research documenting impacts of private politics on myriad firm-level outcomes (King & Pearce, 2010), and the potential for innovation to address societal grand challenges, little is known about how private politics impacts firm-level innovation.

We seek to address this gap by integrating insights from behavioral theory (Cyert & March, 1963) with social movements research to develop theory on how two forms of private politics (Baron, 2012)—contentious and cooperative—impact firm innovation. Contentious private politics seeks to change firm behavior through contentious tactics such as boycotts or protest. Cooperative private politics, relies on interorganizational collaborations (e.g., cross-sector partnerships) between social movement organizations (SMOs) and firms to change behavior. Drawing on behavioral explanations of decision-making (i.e., the decision to pursue innovation) and problemistic search (i.e., where firms look for innovation), we theorize that both contentious and cooperative private politics impact innovation but in different ways. Contentious private politics catalyzes innovation by triggering loss frames which promote managerial risk-taking in response to issues advocated by activists. Cooperative private politics, which triggers gains framing of problems leads to less innovation overall, but is a more effective catalyst for novel innovations by providing firms access to external knowledge and triggering distant search.

We test our theoretical arguments in the context of climate change innovations by 500 large U.S.-based firms, using a hand-collected dataset on contentious and cooperative private politics by 136 environmental movement organizations against those firms over 25 years. We seek to minimize bias associated with nonrandom selection of firms into private politics using a matched sample of firms contentiously targeted, and with SMO collaborations, on climate change issues, and firms that were not targets of private politics on climate issues but had otherwise similar relationships with climate change and other environmental movements, and similar environmental performance and innovation capabilities. Controlling for firms' past green innovation, we find firms targeted contentiously see an increase of 7 percent in patents on the issue advocated by the movement, while firms that collaborate with activists have 12 percent greater novel patents.

Our study contributes to stakeholder perspectives on innovation by theorizing the role of social movements. Past evidence suggests that movements can dampen the commercialization of innovations by stigmatizing new technologies (Weber, Rao, & Thomas, 2009). We investigate if movements can be equally effective at *promoting* innovations that address the issues for which they advocate by directly engaging firms. Our findings accord with a behavioral perspective on incumbent innovation, and contribute to behavioral perspectives on stakeholder management (Nason, Bacq, & Gras, 2018). We situate our study in the context of innovations that help address the societal grand challenge of climate change. However, we believe advancing theory on the impact of social movements on innovation is critical to understanding myriad other technology domains with societal implications, such as the ethics of artificial intelligence, amongst others.

To research on movements and markets, this study offers the first comparative analysis of the impacts of contentious and cooperative private politics on firm outcomes. In doing so, this paper answers calls to explore how firm-activist collaborations impact environmental sustainability (Aguilera, Aragon-Correa, & Marano, 2021), and sheds light on a phenomenon that is growing (Odziemkowska, 2020) but remains "grossly under-theorized within the study of social movements in markets," (McDonnell, Odziemkowska, & Pontikes, 2020: 7). Our findings that both contention and cooperation drive green innovation accord with others' perspectives of institutional change as resulting from both (den Hond & de Bakker, 2007). At the same time, our findings also highlight that the mechanisms underlying their impacts differ. While contentious targeting by movements can spur innovation by threatening damage and losses, collaborations spur more novel solutions to grand challenges by encouraging distant search. As growing numbers of social activists and movements choose between contentious and cooperative private politics to effect change, understanding the consequences of this choice is imperative.

LITERATURE REVIEW

Innovation is not only critical to firms' sustainable competitive advantage, but also a tool for addressing societal grand challenges like climate change (George et al., 2016). While much of the research on firm innovation activities and outputs has focused on internal firm innovation capabilities, or the 'supply-side' of innovation (Adner & Levinthal, 2001), demand-side factors also matter to innovation (see Di Stefano, Gambardella, & Verona, 2012 for a review). For example, demand heterogeneity influences technology life cycles (Adner & Levinthal, 2001), and customer concentration can hinder distant search in innovation (Zhong, Ma, Tong, Zhang, & Xie, 2020). Demand-side influences can also originate from nonmarket stakeholders like governments, which can influence innovation through regulations or subsidies. Di Stefano et al. (2012) conclude that firms' internal science and technology capabilities are a major source of innovation, and demand is the companion that drives innovation in particular economic or institutional directions.

Demand-side explanations are particularly important to green innovation[1] because green innovations produce positive externalities whose returns cannot be entirely be appropriated by the innovating firm. Positive externalities, such as lowered greenhouse gas emissions associated with climate change innovations, accrue to society more broadly and therefore can lead to underinvestment in green innovation by firms (King, 2007). As such, nascent research on green innovation often focuses on government regulation or subsidies in inducing firm innovation whose returns may not accrue entirely to the firm (Costantini et al., 2017; Fu, Li, Ondrich, & Popp, 2018). For example, auto makers' early green vehicle innovations are thought to have been sparked by greenhouse gas emissions policies (Dechezleprêtre, Neumayer, & Perkins, 2015).

[1] Green innovation are innovations that address environment issues, including innovations aimed at energy conservation, pollution prevention, or enabling waste recycling.

In this paper, we seek to extend the demand-side view of green innovation to social movements. Traditionally, social movements research focused on state-facing movements who targeted governments to change regulations, including those regulating firms and markets. In fact, social movements played an important role in new and more stringent environmental regulations on firms in the latter half of the 20th century. In recent decades, however, social movement have diversified into private politics. Private politics focuses on changing the behavior of firms by engaging them directly, whether contentiously or collaboratively, rather than indirectly through changes in public policy or 'public politics' (Baron, 2012). Private politics by movement activists has risen in recent decades as a result of perceptions that government is less responsive, and regulation of corporate behavior is becoming more difficult by single states (Soule, 2009). Contentious private politics, or targeting firms with contentious tactics such as boycotts, protests and shareholder proxy proposals, seeks to change firm behavior by threatening firms' market returns, profitability and reputation (King & Pearce, 2010). Cooperative private politics relies on interorganizational collaborations (e.g., cross-sector partnerships, alliances) between SMOs and firms to change behavior. Prominent examples include the Environmental Defense Fund's (EDF) partnership with McDonald's which resulted in the substitution of styrofoam containers with recycled paper packaging for its hamburgers and a collaboration between Starbucks and the Alliance for Environmental Innovation which gave us corrugated paper sleeves on disposable coffee cups.

Private politics results in myriad responses by firms ranging from resistance, to symbolic or strategically substantive responses. Some firms are resistant to contentious targeting (Briscoe & Safford, 2008), opting to ignore or counter activist claims of wrong-doing. Others respond by making prosocial claims (McDonnell & King, 2013), engaging in externally-focused framing

(Hiatt, Grandy, & Lee, 2015), changing practices to conform with movement demands (Briscoe et al., 2015), and divesting contested assets (Durand & Vergne, 2015; Soule, Swaminathan, & Tihanyi, 2014). Research has also highlighted that firms are responsive to movements contentiously targeting industry peers because this raises the prospect that they will become targets in the future. In response to peer targeting, firms have been shown to alter location choices (Yue, Rao, & Ingram, 2013) or adopt new practices (Briscoe et al., 2015). As most research to date has focused on contentious private politics, comparatively less is known about cooperative private politics (Heyes & King, 2020). Researchers of firm-nonprofit collaborations—of which SMOs are a subset—often conceptualize them as resource-seeking or -combining relationships (Austin & Seitanidi, 2012; Murphy, Arenas, & Batista, 2015), which allow partners to tap valuable resources they lack. For firms, collaborations with nonprofit organizations offer reputational benefits, access to new networks and markets, and partners' unique knowledge of complex social problems or contexts (Gray & Purdy, 2018; Murphy et al., 2015; Yaziji & Doh, 2009). King (2007) suggested that collaborations between environmental nonprofits may also push firms towards more environmentally-friendly practices when the nonprofit invests in an asset with environmental and financial benefits, thereby lowering costs to the firm.

Efforts to theorize and empirically investigate how private politics influences firm innovation activities are nascent. One mechanism by which movements impact innovation is by stigmatizing problematic technologies (Vasi & King, 2019). In Europe, the anti-genetic movement reduced biotechnology commercialization by pharmaceutical firms by weakening internal champions and commitment to the technology, and raising perceptions of investment uncertainty (Weber, Rao, & Thomas, 2009). What is less clear is whether movements can be equally effective at promoting innovations that address the issues for which they advocate by directly engaging firms. In the context of green products and innovation, evidence suggests managers are attuned to movement actors. For example, movement organizations' support for specific technologies or product markets is associated with firms' entry into those markets (Durand & Georgallis, 2018), and firms operating in states with more environmental nonprofits produce more green patents (Berrone et al., 2013). At the same time, the degree to which these findings translate to movements directly targeting firms is uncertain given the wide array of more symbolic responses available to firms (Hiatt et al., 2015; McDonnell & King, 2013). The prospects for firm-SMO collaborations to increase innovation is equally uncertain as some SMO participants question whether collaborations result in any substantive change in business practices (Burchell & Cook, 2013).

In this paper, we draw on the behavioral theory of the firm (Cyert & March, 1963) to theorize the effects contentious and cooperative private politics have on innovation outcomes at the firm-level. Behavioral theory is commonly employed in studies of firms' innovation processes and outcomes, because it offers explanations for the decision-making stage of innovation (i.e., the decision to pursue innovation) as well as the search processes involved in innovation processes (i.e., where firms look for innovation). Using these two features, we consider how contentious and cooperative private politics have distinct impacts on both decision making as well as search, and therefore have differential impact on the volume and novelty of innovation firms pursue on the issue advocated by activists.

HYPOTHESES

Social movements employ private politics to bring managerial attention to issues in the hope firms will improve their performance. By bringing attention to firms' underperformance on an issue, social movements can trigger problemistic search within the organization for solutions or responses (Cyert & March, 1963; Posen, Keil, Kim, & Meissner, 2018). There are myriad ways firms can respond to environmental problems brought to their attention by movements. For example, firms can implement off-the-shelf environmental innovations which can be obtained in the market (Berrone and Gomez-Mejia, 2009). When Starbucks collaborated with the Alliance for Environmental Innovation for solutions to the waste created by double-cupping of hot coffee, they settled on an off-the-shelf solution: corrugated paper sleeves. Compared with off-the-shelf solutions, pursuing green innovation in-house "is riskier, requires greater financial commitment, and usually accrues returns in the long term" (Berrone et al., 2013: 891). Thus, a natural starting point for our inquiry is how private politics impacts risk taking in problemistic search, and therefore, innovation.

While Cyert and March's (1963) behavioral theory does not directly predict firm risk taking (i.e., it applies directly to search and change), scholars integrate insights from prospect theory to understand when firms choose more or less risky alternatives in their problemistic search processes (Argote & Greve, 2007). Decision makers' risk preferences change with the framing of problems, and particularly gains versus loss frames. In an experiment where only the framing of the problem changed from losses to gains, Tversky and Kahneman (1981) show decision makers are risk averse when the problem is framed as a gain, and risk taking when the problem is framed as a loss. Management scholars applying this insight to research on innovation found that poorly performing firms are more likely to purse investments in research and development (Bolton, 1993; Greve, 2003) and to launch innovations (Greve, 2003). The mechanism linking underperformance and innovation is that low performance increases managerial tolerance for risk because it is viewed as a loss situation where they are more willing to take risks, including innovation, to improve it (Greve, 2003).

While behavioral theory typically conceptualizes losses or gains in terms of past performance or aspiration levels, we submit that private politics can likewise trigger loss or gain framings of problems. In their theory of activists' tactics to influence corporate practices, den Hond and de Bakker (2007) highlight two different mechanisms underlying contentious and cooperative private politics. Contentious private politics operates by threatening material or symbolic damage to the firm, prompting change or abandonment of a practice by raising the costs of continuing the contested practice. Activists can threaten material damage through tactics such as boycotts or blockades which can reduce, or outright stop, revenue streams from products or assets (Odziemkowska & Dorobantu, 2020), or symbolic damage to firms' reputations through media campaigns, protests and other means (den Hond & de Bakker, 2007). Cooperative private politics, on the other hand, operates by offering a reward of material or symbolic gain for new practices. For example, an SMO could offer material gain by lending its logo to a firm's green product line (Hartman & Stafford, 1997), the prospect of reducing operational costs through greener practices (Hart, 1995), or symbolic gain through green awards and rankings that improve reputation.

By threatening damage or offering gains (den Hond & de Bakker, 2007), contentious and cooperative private politics result in different problem framing inside the firm. Firms facing contention (i.e., boycott, protest) are more likely to view the problem being brought to their attention through a loss-frame. That is, managers will consider the choice to innovate in terms of the losses that contentious targeting threatens. Conversely, firms facing cooperative tactics are more likely to view the problem at hand through a gain-frame. In evaluating alternative choices, they are more likely to focus on the gains offered by cooperative private politics. Since prospect theory predicts riskier actions in the face of damage or loss and more conservative actions in the face of gains (George, Chattopadhyay, Sitkin, & Barden, 2006), we expect that contentious private politics will result in greater investments in innovation, compared to cooperative private politics. Put another way, firms will be more willing to invest in innovation when faced with contention because losses loom larger than gains and managers are more likely to take risks in order to avoid losses than to acquire gains (Tversky & Kahneman, 1981). Thus, we propose:

H1: Contentious private politics against a firm is associated with a greater increase in the volume of green innovation by the firm than cooperative private politics.

The responsiveness of firms to contentious private politics is not limited only to instances when they are targets. Firms are responsive to contentious targeting of other firms (Briscoe et al., 2015), and particularly those operating in the same industry (Yue et al., 2013). Protests and boycotts send informational signals to non-targeted firms about the urgency of stakeholder demands (Eesley & Lenox, 2006), and increase the risk of them becoming targets in the future because activists often target firms sequentially (Baron & Diermeier, 2007). PETA's campaign to improve treatment of animals in the early 2000s, for example, began with McDonald's, but spread quickly to other fast-food companies, including Burger King, Wendy's, and Kentucky Fried Chicken. Non-targeted firms that fail to proactively respond to movements' targeting their peers risk becoming targets themselves in the future.

Given past evidence that firms are responsive to their industry peers being targeted contentiously, we expect the same to be true for firms' pursuit of green innovation. While contentious targeting of industry peers does not necessarily inflict damage or losses directly on the focal firm, it does raise the chances that damage or losses from contention are forthcoming in the future (Baron & Diermeier, 2007). Thus, firms seeing contention (i.e., boycott, protest) against their peers, may be prompted into problemistic search, and see the problem as a potential future loss should they be targeted in the future. Because the focal firm is not directly experiencing losses, we expect the effect of peer targeting by activists to be lower than direct contentious targeting.

Therefore, alongside the effects contentious private politics directly targeting the focal firm have on green innovation, we also expect that contentious targeting of a firm's industry peers increases green innovation by the focal firm, albeit to a lesser extent.

> *H2: Contentious private politics against a firm's industry peers is associated with a greater increase in the volume of green innovation by the firm than cooperative private politics.*

In addition to differentially influencing the volume of innovation, private politics may also differentially impact the nature of the innovations pursued through its effect on where firms search for solutions to issues brought to their attention by movements. Incumbents typically search in knowledge domains already familiar to them (Fleming, 2001) or close to their expertise (Katila & Ahuja, 2002), in line with behavioral theory's assertion that problemistic search is typically local (Cyert & March, 1963). While there are advantages to local search (Posen et al., 2018), most novel innovations, prized for their impact on innovation capabilities, competitive advantage and long-run performance, result from distant search (Fleming, 2001). One way by which firms stimulate more distant search and novel innovation is by accessing new and diverse knowledge outside the firm, including from geographically proximate firms (Bell, 2005), interorganizational alliances (Rosenkopf & Almeida, 2003), universities (Zucker & Darby, 1998), or end users (von Hippel, 2006).

We argue that collaborations with SMOs (i.e., cooperative private politics) can also be a source of new knowledge and distant search that catalyzes novel green innovation. Firm motivations for entering intensive collaborations[2] are varied, but include "access to environmental expertise", and "obtain[ing] external endorsement of environmental solutions" (Rondinelli & London, 2003: 65).

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[2] We focus our theorizing on collaborations Rondinelli and London (2003: 65) classify as *intensive* because these "involve collaborating on internal corporate processes and product development" and therefore are most likely to impact firm-level innovation. These are distinguishable from interactive collaborations that are outward focused including co-developing a public education campaign or public policy proposal.

Both are possible pathways by which cooperative private politics drives novel green innovations by: 1) offering access to novel knowledge enabling more distant search for environmental solutions; and 2) lowering the risks of pursuing novel innovation by focusing on solution spaces acceptable to stakeholders.

Beginning with the first, many SMOs possess considerable scientific and technical expertise in issue domains on which they advocate. Collaborations with SMOs are a primary way by which firms can access knowledge held by SMOs "since internal development of such expertise may be too costly, inefficient, and time-consuming for most companies, and merger with or acquisition of an [SMO] is highly unlikely" (Rondinelli & London, 2003: 62). Intensive collaborations with SMOs typically involve SMOs observing, and sometimes directly participating in, the internal operations of the firm. While this transparency opens up the firm to scrutiny, the firm can "benefit through increased access to outside information from external stakeholders" (Desai, 2018: 239). As advocates on environmental issues, SMOs are effectively experts in solution spaces distant from, or unknown to, firms, and therefore are more likely to generate novel problem solutions (Jeppesen & Lakhani, 2010). In comparison, the problemistic search triggered by contention is predominantly local in nature (Cyert & March, 1963), and therefore may be less effective at producing novel innovations. One executive involved in the waste-reduction collaboration between McDonald's and EDF, noted "Given the lofty title [Vice President of R&D], I imagined a bunch of Einsteins developing innovative new packaging. Instead, these researchers mostly pursued continuous improvement in the existing process. To stimulate innovation is challenging. Working with NGOs like EDF unlocked a lot of innovation" (Langert, 2019: 25). Moreover, unlike inter-firm alliances where frictions to knowledge sharing stem from fear of knowledge appropriation (Ghosh & Rosenkopf, 2014), interorganizational knowledge flows are not encumbered by such concerns in firm-SMO collaborations because there is no "tension between cooperation and competition or racing to outlearn one's partner" (Rondinelli & London, 2003: 70). In one instance, Greenpeace freely transferred critical hydrocarbon refrigeration technology to a company because its ultimate goal was the diffusion of environmentally friendly products (Hartman & Stafford, 1997).

In addition to broadening the search space for green innovations, SMOs may also encourage novel innovation by identifying "areas of a search space that contain alternatives acceptable to stakeholders" (Olsen, Sofka, & Grimpe, 2016: 2233). Firm-SMO collaboration typically involve the SMO helping the firm evaluate competing solutions. When McDonald's sought EDF's help in reducing waste, the two partners collaborated to evaluate several alternative solutions, and ended at a solution most acceptable to key waste/recycling stakeholders. Given the considerable costs and risks involved in pursuing novel innovation (Fleming, 2001), increasing the probability that a broad range of stakeholders find the solution acceptable is important. As King (2007) argues, companies taking on extra costs of innovations that reduce environmental impacts are subject to the risk that stakeholders will not provide them with an ongoing stream of payments for the innovation. Such risk is reduced when collaborations with SMOs are involved because SMO's intimate knowledge of stakeholder concerns help firms identify solutions that will receive stakeholder acceptance and support (Olsen et al., 2016).

The preceding suggests that cooperative private politics may be comparatively more effective at increasing novel green innovation than contentious private politics. Contentious private politics does not offer opportunities for new knowledge transfer in distant search spaces, nor does it reduce the risk that more novel innovations are rejected by the investing firms' stakeholders. Therefore, we propose:

H3: Cooperative private politics against a firm is associated with a greater increase in the volume of novel green innovation by the firm than contentious private politics.

DATA AND METHODOLOGY

Sample

To test the impact of private politics on green innovation, we hand-collected data on all contentious and cooperative interactions between a sample of 500 large U.S. companies and 136 U.S.-based environmental SMOs from 1988 to 2012. It is believed that the first firm-SMO environmental collaboration is the 1990 waste-reduction partnership between the EDF and McDonald's (Svoboda, 1995). Since then, firm-SMO collaborations have gained more recognition and gradually turned into a common practice for the Fortune 500 companies (Economist, 2010).

Our firm sample consists of 500 companies randomly selected from all companies that appeared in the Fortune 500 list for three or more years during our sample period. We believe that the Fortune 500 sample is appropriate as prior research has shown that movement activists tend to target large, high-status and highly visible companies, as well as form collaborations with them (King, 2008; McDonnell, King, & Soule, 2015; Odziemkowska, 2020).

We relied on both media-based search and an archival directory to determine our sample of SMOs. Activism and advocacy are key functions of SMO (Soule & King, 2008) which distinguish them from service-oriented nonprofits (Minkoff, 1999). We therefore searched for all organizations described as an "environmental activist group/organization" or "conservation activist group/organization" or "environmental advocacy group/organization" in Factiva archives of US newspapers. This media-reported sample was then supplemented with nonprofit organizations engaging in advocacy on environmental issues according to the National Taxonomy of Exempt Entities Core Code (NTEE-CC) during the sample period. The code and data are maintained and provided by National Center for Charitable Statistics (NCCS). Non-advocacy nonprofit organizations (i.e., service-oriented) or those that never interacted with the 500-firm sample are excluded from our sample since they do not engage in private politics. We further excluded those organizations in NCCS that were not independent (i.e., corporate-backed). The final sample consists of 136 environment SMOs. By not restricting our search exclusively to archival sources, this SMO sample generation approach mitigates concerns that small movement organizations are underrepresented (Larson & Soule, 2009).

Data Sources and Key Constructs

Identifying firm-SMO interactions. We follow the conventional approach in social movements research by collecting data on firm-SMO interactions from media reports, and supplement this with press releases as well as firms' financial filings. The use of media reports may create two types of bias: selection bias (e.g., ideological bias or over-reporting of negative events) and description bias (i.e., the veracity of information covered) (Earl, Martin, McCarthy, & Soule, 2004). We address selection bias by including all English-language North American sources in Factiva from major news, business publications, and press release wires[3] instead of relying on one media outlet. Our inclusion of press releases and firms' financial filings (i.e., 10-Ks), mitigates the bias created by media's over-reporting of negative news, as the former two sources tend to report more positive news. To alleviate description bias, our identification of firm-SMO interactions relies on the hard facts of the event (e.g., who, what, when) which is relatively accurate in media reports (Earl et al., 2004).

A search of these archival sources produced over 94,000 media reports, press releases or firm filings where a firm name and a SMO name appear in the same document. Each resultant document

[3] The Factiva major news and business publications category includes over 100 print and online news outlets such as ABC News, the Boston Globe, and the Wall Street Journal. The press release wire category includes over 200 press release wires such as Business Wire, Greenwire, and Nasdaq/Globenewswire.

was then read by research assistants and reviewed by the first author to identify cases where the SMO either contentiously (e.g., protests, boycotts, proxy proposals, lawsuits), or cooperatively (e.g., donations, award, collaboration) interacted with a firm. The most common forms of contentious interactions were protests, lawsuits, letter-writing or media campaigns, and actions against the firm with regulators. The most common ways by which firms cooperated with SMOs were corporate donations, participation in or support for SMO programs, and formal collaborations. All events are assigned unique identifiers to deduplicate the same event appearing in multiple sources and to calculate media attention for each event. Finally, each interaction is coded with the specific environmental issue being advocated in the interaction, according to the Comparative Agendas Project (CAP) topics codebook (Baumgartner & Jones, 2002). Environment issues identified by CAP include drinking water quality, hazardous waste, air pollution, species and forest protection, and renewable energy, amongst others.

We derive measures of contentious and cooperative private politics from this database of firm-SMO interactions. Contentious private politics includes all instances of an SMO contentiously targeting a firm (Baron, 2012) with tactics such as a protest, letter-writing or media campaign, or legal or regulatory action. Cooperative private politics, on the other hand, include all formal collaborations that a given firm has with SMOs on a given environmental issue (Baron, 2012). We identified firm-SMO collaborations from the broader category of cooperative interactions generated by the search described above by reading each report carefully to identify those cooperative interactions that meet the definition of firm-SMO collaboration: organizations working together by committing resources to achieve mutually relevant outcomes (Odziemkowska, 2020). Similar to definitions adopted in research on strategic alliances between firms (Kale & Singh, 2009), this definition highlights that organizations *interact* (i.e., relationship of some duration exists where parties interact directly) in a *purposeful* way (i.e., with a goal of creating outcomes), and that each party *commits resources* (i.e., financial, physical, or human capital etc.), to pursue a mutually relevant *outcome.* Cooperative private politics excludes those cooperative interactions that are purposeful but involve only arms-length transactions, such as a firm donating to a SMO, licensing an SMO's logo, or participation in an SMO program. Firm-SMO collaborations were further coded to distinguish between intensive and interactive collaborations (Rondinelli & London, 2003), as our theoretical arguments pertain to intensive collaborations where a firm and SMO work on internal environmental management problems.

Identifying firms' green innovation. Previous studies on environmental innovation have operationalized green innovation using questionnaire surveys (e.g.,Christmann, 2000; Rogge & Schleich, 2018) or patents classified as 'green' based on patent technology classes (e.g.,Amore & Bennedsen, 2016). We opted to follow the second approach (i.e., green patents), to minimize concerns about social desirability bias associated with surveys, and to not muddle adoption of off-the-shelf environmental solutions (Berrone et al., 2013) with those pursued internally.

Patent data is a commonly used robust indicator of innovation (Ahuja & Katila, 2004; Arora, Belenzon, & Sheer, 2017) as it represents novel knowledge carefully screened by experts (i.e., patent examiners) from the United States Patent and Trademark Office (USPTO). The comprehensive classification schema of patents, developed by the USPTO, classifies each patent to a specific technological class. This feature also recommends a patent-based measure for innovation, as it allows us to match each patent's technology class to the particular environmental issue (e.g., toxic chemicals, renewable energy, air pollution) that is the subject of firm-SMO interactions. We obtained data on successful patent applications[4] from *PatentsView*, a patent

[4] Measuring firms' innovation using successful patent applications is more accurate (e.g., Ahuja & Katila, 2004; Polidoro & Theeke, 2011; Yang, Phelps, & Steensma, 2010), as it may take years for a patent application to be

database maintained by the USPTO, and also from Kogan, Papanikolaou, Seru, and Stoffman (2017), who have matched all patents from 1926 onwards to firms whose financial returns data are in the Center for Research in Security Prices. Patent information contains the assignee name, technology class, the year applied and also the citation network between all patents (i.e., who cites who).

To identify green innovation, we combined two mappings of patent technology classes to environmental issues: Amore and Bennedsen (2016); and, the Environmentally Sound Technologies (EST) Concordance from the USPTO. We did so since the former approach covers only two environmental issues—air pollution and renewable energy—while the USPTO has mapped technology classes to more environmental issues,[5] including energy efficiency which is relevant to our focus on climate change, and has a more fine-grained patent classification system. These mappings classify patents based on their primary technology classes to a broad environmental category (e.g., "air pollution control", "solid waste disposal", "water pollution", "alternative energy" etc.). We matched the broad environmental categories these two mappings provide to the CAP codebook categories of environmental issues (i.e., the issue classification system we used to code the firm-SMO interactions). In instances where there was imperfect or ambiguous overlap in environmental issues, we read the technology class description, and sought expertise in that domain, to ensure accuracy in our matching of CAP categories to Amore and Bennedsen (2016)/USPTO's EST Concordance. In instances where a technology class is mapped

granted (Hall, Jaffe, & Trajtenberg, 2001). Thus, patent applications (as opposed to granted patents) are a timelier reflection of firms' innovation activities at a point in time. The empirical results, however, are consistent when we use granted patents and lag our explanatory variables for two years.

[5] In the EST Concordance, there are five broad topics to classify patent class/subclasses: 1) alternative energy production, 2) energy conservation, 3) environmentally friendly farming, 4) environmental purification, protection, or remediation and 5) regulation, design, or education. Under each broad topic, there are multiple subfields pointing to more specific problems. For a complete list, please refer to https://www.uspto.gov/web/patents/classification/international/est_concordance.htm.

to more than one environmental issue, we assigned patents in that class to all related issues and divided the patents by the number of issues they were assigned to when constructing our patent count measures. For robustness, we also constructed a patent count measure that instead randomly assigned those patents to one of the issues to which it was mapped.

Given our focus on climate-related innovation, we test our hypotheses using patents that fall into three environmental issues corresponding to climate change: code "705" (air pollution, and global warming); code "806" (alternative and renewable energy); and, code "807" (energy conservation). In our estimations, we also use firm patents corresponding to other environmental issues (e.g., water pollution) to control for firms' other green patenting activity.

Empirical Design

We identify the effects of private politics on innovation by estimating the impact that contentious targeting and collaborations have on the patenting activity of the firm in the specific issue being advocated by SMOs (e.g., protests advocating for energy conservations and patents associated with energy conservation). In other words, we test our hypotheses at the firm-issue-year level, which we believe to be the most stringent approach because it identifies off changes in patenting activity at the issue level (i.e., rather than changes in all 'green' patents). We sought to account for the non-random assignment of firms to contentious and cooperative private politics by estimating effects on a matched sample of firms. Firms contentiously targeted by movements, or firms with SMO collaborations, may be different from other firms in ways that differentially influence their innovation output. To minimize the effects of this potential bias we identify a sample of firms closely matched to the contentiously targeted firms, and those with intensive collaborations, on observables that predict contention, collaboration, and innovation.

We use coarsened exact matching (CEM) to identify the plausible counterfactual firms for each contentiously or collaboratively treated firm on a given climate-related issue (Iacus, King, & Porro, 2012). Because our goal was to find firms that were as close as possible to the 'treated' firms prior to contention or collaboration on dimensions that could predict both, we matched on the focal firm's relationships with other environmental movements (e.g., biodiversity) as well as the focal movement (e.g., energy conservation). First, we match on the number of times the firm has been contentiously targeted by non-climate related movements (e.g., waste reduction, biodiversity) in the previous three years. The rationale behind this is to account for firm-level unobservables that make some firms more attractive targets for contentious private politics. If a firm has been targeted by one movement, it may have some characteristic that makes it a good target but one not easily observable by researchers. Second, we matched on the number of cooperative arms-length interactions the firm has had with SMOs on the focal issue (e.g., energy conservation, air pollution, renewable energy) in the previous three years. Cooperative arms-length interactions include corporate donations, employee volunteering for the SMO, SMO giving the firm awards, and other forms of cooperation not classified as formal collaborations (see Odziemkowska and McDonnell, 2019 for other examples). Past cooperation between a firm and movement demonstrates the firm's attention to the issue advocated by the movement and increases the probability that the firm has a formal collaboration on the focal issue (Odziemkowska, 2020). Because both variables are highly skewed (i.e., most observations are between 0 and 2), we categorize firms into coarsened 'bins' for each variable and firms are matched within these bins—the bins are 0, 1, 2 to 5, and above 5. Additionally, we matched on a dummy variable denoted one if the firm had a non-intensive collaboration on the focal issue, and zero otherwise. Our hypotheses focus on intensive collaborations, but these are more likely to materialize with firms that have had other types of collaborations on the same issue (Austin & Seitanidi, 2012).

We also matched on other firm-level characteristics that influence both private politics and firm innovation. We focus on our rationale for their inclusion in the matching here, and explain their measurement and sources below. We matched on firm size and firm media attention because activists favor large and prominent firms for contentious targeting because they bring attention to their cause (McDonnell et al., 2015) and for collaborations because they are more likely to propagate new practices (Odziemkowska, 2020). We matched firms on their environmental performance because poor environmental performance is associated with greater contention against the firm and may be associated with green innovation. Finally, we matched firms on two covariates of innovation: firm technological diversity and firm R&D intensity. Technological diversity reflects firms' capabilities in combining firm-specific knowledge and coping with risks associated with the market environment and innovation process itself (Wang & Chen, 2010). R&D intensity reflects how intensely a firm pursues innovation relative to its size (Wang, He, & Mahoney, 2009). These variables are important predictors of a firm's patenting behavior and may affect how SMOs select their targets. We also control for other important variables such as the previous year's patenting activity, firm profitability and slack resources but these are not included in the matching procedure to limit the loss of observations.

Measures

Dependent variables. We constructed two dependent variables to assess a firm's innovation on climate-related issues. First, we measured the number of *green patents,* defined as the total number of green patents applied for by a firm in a given year on a given environmental issue. Second, we measured *novel green patents,* defined as the total number of novel green patents among all the green patents applied for by the focal firm in a given year and environmental issue. We followed prior research on novel patents (Fleming, Mingo, & Chen, 2007; Funk, 2013) to define a patent as novel if its combination of subclasses is new compared with all previous patents that have ever been granted until then.[6] In instances when a patent belongs to multiple environmental issues, we divided the patent over the number of issues to which the patent belongs when counting the sum of both green patents and novel green patents.[7] To address the skewness of our measures, we use the natural logarithm transformation of the two variables (i.e., one plus the count number) in our analysis. Log-transforming the dependent variables also enables us to use linear estimation which better accommodates multiple fixed effects important to our identification of effects than count models.

Independent variables. We test our hypotheses regarding contentious and cooperative private politics using the sum of all *contentious interactions* a firm received by any SMO (e.g., protest) in a given year on a given environmental issue, and the sum of *intensive collaborations* it had with any SMO in a year[8] and environmental issue, respectively. Intensive collaborations are those focused on tackling internal environmental management practices (e.g., SMOs working directly with firms to changing products or processes), which we believe to be most pertinent to firms' innovation activities. To test hypothesis 2, we measure *industry contentious interactions* as the

[6] The USPTO updates the subclass system regularly as technologies evolve. All patents dating to the USPTO founding year (1790) are assigned to reflect the updated classification. We obtained the Patent Grant Master Classification File available at https://www.google.com/googlebooks/uspto-patents-class.html. For a given patent, if the combination of its subclasses is new, it is counted as novel.

[7] We tested the robustness of our measures by randomly assigning a patent to an environmental issue whenever it is categorized into multiple issues.

[8] Unlike contentious interactions, formal collaborations typically span multiple years. For over half of collaborations, we were able to identify the duration directly from the announcement, or using reports of the collaboration's outcome (we assume the collaboration concludes when the goal is met). For the remaining collaborations, we assume a three-year life span, which is the sample median for collaborations whose duration is available, and consistent with alliances research (Schilling & Phelps, 2007).

sum of contentious challenges other firms in the same industry (three-digit NAICS) in which the focal firm operates received on a given environmental issue.

Control variables. We controlled for a number of factors that may affect firms' green innovation activities and may be correlated with our hypothesized effects of private politics. First, following the rationale of our matching approach, we include controls for the firm's myriad relationships with other environmental movements and the focal movement which could affect private politics: *contention on non-climate issues*; *cooperative arms-length interactions*; and the number of *interactive collaborations*.[9] We controlled for the firm's *environmental performance* measured as the sum of seven environmental concerns ratings evaluated by Kinder, Lydenberg, Domini (KLD) Research & Analytics (Chatterji, Levine, & Toffel, 2009).

We also include a control to account for differences between firms in their responsiveness to issues (Durand, Hawn, & Ioannou, 2019), which could in turn influence their propensity to be targeted (McDonnell et al., 2015). We matched each firm to the Sustainability Accounting Standards Board's issue materiality classifications to account for the materiality of specific environmental issues to a firm's business strategy and performance (Grewal, Hauptmann, & Serafeim, 2020), which may evoke different responsiveness from the firm but may also be predictive of innovation or private politics. *Issue materiality* is a dummy coded one if the issue (e.g., renewable energy) is material to the firm, and zero otherwise. We also controlled for a *firm's public approval*, as highly esteemed firms are more likely to be contentiously targeted and may have greater innovation capabilities. Following McDonnell (2016), we used Linguistic Inquiry Word Count dictionaries to assess the affective valence of all articles published about the firm in

[9] Interactive collaborations are those focused on outcomes external to the firm such as co-developing educational programs or conducting joint policy research (Rondinelli & London, 2003).

USA Today and employed the Janis-Fadner coefficient to calculate each firm's emotional valence of media coverage. The coefficient ranges from negative one (all negative) to one (all positive).

Innovation also depends on a range of firm-level factors that affect the supply-side of the innovation equation. Thus, we controlled for *firm assets* (logged), *return on assets* as a proxy for financial performance, *market leverage* (ratio of debt over a firm's capital), as well as *slack resources* (current assets over current liabilities) (Greve, 2003). *R&D intensity* (research expenses divided by total sales) is another important predictor of firm innovation and is included in the estimation. We obtained financial data from COMPUSTAT to calculate these five controls. We also included measures of firm-level patenting behavior as they are directly related to future patenting. We controlled for a firm's *patent stock* measured as the logged sum of patents assigned to the firms over the past five years, and its *patent quality* measured as the logged sum of forward citations over the proceeding years (three-year window) accrued to a firm's patents in a particular year. *Technological diversity* was measured as the Blau index, ranging from zero to one, of a firm's patenting across technological classes in a year (Wang & Chen, 2010). To indicate the relative richness of the firm's specific environment (i.e., some firms may patent in technological classes that have more new innovations than other firms) (Ahuja & Katila, 2004), we measured *industry technological opportunity* as the logged sum of patents granted in the classes where a firm has been active. Because firm patenting is path dependent, we include in our main estimation the lagged value of our dependent variables (logged sum of green patents, logged sum of novel green patents). Since there are cases when a patent may belong to several issues, we generated a *ratio of multiple-issue green patents* (total number of multiple-issue green patents over all green patents) as a control in all analyses.

Given the importance of public policy to inducing green innovation, which may also correlate with private politics (Hiatt et al., 2015), we include two public policy control variables consistently available over our panel. We obtained yearly measures of state-level policies over eight decades (1936-2014) from Caughey and Warshaw (2016), and controlled for state-level policies on *solar energy use* (i.e., whether the state has a tax credit for residential solar installations). In addition to the influence of state-level policy, firms monitor and may be responsive to future policy changes. Thus, we include a control for the number of *congressional hearings held on the issue*, in the previous year, from the Comparative Agenda's Project. All explanatory and control variables are lagged by one year. Recognizing that a one-year lag between innovation and our explanatory variables is short, we also probe the robustness of results to longer lags (e.g., two- and three-years). Results are substantively similar with longer lags, with larger effect magnitudes (results available from authors). Table 1 shows the summary statistics and correlations for the matched sample.

Insert Table 1 about here

RESULTS

We use the high-dimensional fixed effects model developed by Correia (2016) which more efficiently estimates multiple fixed effects, and is useful for our analysis spanning three levels (firm, issue and year). This model has been increasingly adopted in both strategy (Dutt & Mitchell, 2020) and other disciplines such as economics and finance (Adams, Keloharju, & Knüpfer, 2018), because of its flexibility in incorporating multiple fixed effects and standard error correlation structures. In our specification, we include firm and issue fixed effects to control for unobserved heterogeneity across these two levels. We also include a year and two-digit SIC code[10] industry interacted fixed effect to account for any industry time-varying shocks. All models include heteroskedasticity robust standard errors clustered by firm to account for the nonindependence of firm observations across the three climate-related issues (i.e., air pollution, renewable energy, energy conservation) and over time. We estimate the model using the Stata *reghdfe* package.

Insert Table 2 about here

Table 2 reports the results of our hypothesis tests using linear models with multiple fixed effects. The dependent variable in models 1 through 4 is the logged number of patent applications on a given climate change issue (i.e., air pollution, renewable energy, or energy conservation). In model 1 we include only control variables, and find that a firm's green patenting relies on its stock of knowledge, whether the specific issue is material to its performance, whether the state has a tax credit for residential solar installations, and the previous year's green patents. In model 2, we find evidence corroborative of our first hypothesis that contentious private politics is a more effective catalyst for green innovation in general than cooperative private politics. Results indicate that while firm-SMO intensive collaborations on an issue do not significantly increase firms' green innovation (p=0.079, beta=0.124), contentious private politics is positively associated with green innovation (p=0.002, beta=0.121). A one unit increase in the contentious challenges against a firm on a given climate change issue is associated with a 12 percent increase in green patenting on that issue. In hypothesis 2, we posited that firms are also responsive to contentious challenges targeting firms in the same industry and so will increase green innovation in response. In model 3, the coefficient of contentious challenges received by firms' industry peers is positive and significant

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[10] We chose to set the industry fixed effect at the two-digit SIC code level as the three-digit SIC code level would include very few firms for each group, in our cross-industry firm sample.

(p=0.017, beta=0.053). A one unit increase in the contentious targeting of industry peers on a given issue is associated with a 5 percent increase in the focal firm's green patenting on that issue. As we expected, the magnitude of the effect of contentious private politics against industry peers is less than if the focal firm is targeted, but is nevertheless significant. Model 4 is the full model with all independent variables included simultaneously and the results continue to corroborate our first two hypotheses. In the full model, firms targeted contentiously increase their patenting by 7 percent on the issue advocated by the movement, and 4 percent when industry peers experience contention. The effect sizes are substantive, corresponding to 59, and 33, percent of one standard deviation in green patenting, respectively. In supplementary analysis (available from the authors), we confirm that results remain unchanged when the dependent variable was constructed by randomly assigning patents belonging to several environmental issues to one of them in counting the total number of patents. Results are also robust to removing the lagged dependent variable, and estimating the model on the full firm sample (i.e., without matching).

To further probe the plausibility of the mechanism we propose links contention and innovation—loss-frames—we investigated if the type of contentious tactic employed and issue materiality mattered to firm innovation responses. Our theoretical arguments would suggest that tactics that threaten greater and more immediate material damage should produce stronger responses. Model 9 in Table 3 confirms that contention that relies more heavily on tactics such as shareholder resolutions, regulatory interventions and lawsuits against the firm has the most pronounced effect on green innovation (p=0.042, beta=0.138). We also find that the positive relationship between contention and innovation only exists for issues material to a firm's business strategy and performance (Grewal et al., 2020), consistent with risk-taking to prevent losses on material issues. Model 10 shows that contention on material issues is associated with a 49 percent increase in the focal firm's green patenting on that issue (p=0.002). Figures 1 and 2 plot the marginal effects of contention that involves disproportionally more material tactics, and contention on material issues, respectively.

We also investigated if contentious private politics against a firm correlates with risk perceptions by its leaders, and in turn, if greater perceptions of risks related to environmental issues correlate with green innovation. We perform this analysis using data from Hassan, Hollander, Van Lent, and Tahoun, (2019), who used computational linguistics to construct a measure of risk by specific issue reflected as the share of a company's quarterly earnings conference calls that is devoted to discussing that issue using language related to risk. Linear regression models with identical controls and fixed effects as our main models and environmental risk as the dependent variable (i.e., the percentage of earnings calls devoted to environmental risks), indicate firms contentiously targeted at least once in the previous year on material environmental issues spend more time discussing environmental risks in their quarterly earnings calls (p=0.002, beta=0.024; full model results available from authors). Figure 3 plots the results of that model, comparing firms contentiously targeted at least once on a material issue in the previous year, and those targeted on non-material issues, to those not contentiously targeted. In model 10 in Table 3 we substitute the measure of contentious private politics against the firm with a lagged version of environmental risk measure to confirm that the percentage of quarterly earnings calls devoted to environmental risks is positively correlated with green innovation (p=0.045, beta=0.026). In model 11, we show our main results are robust to issue and year interacted fixed effects (in addition to firm and industry fixed effects) to account for any issue time-varying shocks. This ensures that regulatory or legislative shocks that we cannot measure and are not correlated with congressional hearings held on an issue (our existing control variable) are not biasing our results.

Insert Table 3 and Figures 1 to 4 about here

We now turn to our third hypothesis which posits that collaborations, or cooperative private politics, are more likely to impact the direction of the innovation firms pursue. Specifically, we posited that while contention may drive green innovation overall (i.e., hypothesis 1 and 2), intensive collaborations are more effective catalysts for novel innovation. Models 5 through 8 present corresponding analysis where the dependent variable is the logged number of novel patent applications on a given climate-related issue. In model 5, the controls-only model, we find that technological opportunity constrains firms' tendency to search for more *novel* solutions, consistent with arguments that technological opportunities may increase rivalry and innovation uncertainty (Kumar, 2005). We also find that the firm's public approval, a state-level solar energy policy, and the previous year's novel patents, are associated with more novel green innovation. As both model 6 and model 7 report, a firm's intensive collaborations with SMOs are more effective at catalyzing firms' novel green innovation (p=0.019, beta=0.117 in model 6; p=0.022, beta=0.117 in model 7), than contentious private politics, in line with our third hypothesis. The addition of one intensive collaboration with an SMO is associated with a 12 percent increase in novel innovations tackling the environmental issue, and corresponds to a change of more than one standard deviation in novel green patents. Model 8 presents the full model where cooperative private politics continues to be positively and significantly (p=0.020, beta=0.118) associated with novel green innovation.

Overall, our results suggest that contentious challenges, whether directed at the focal firm or its peers, exert a more significant and positive influence on firms to generate green patents than collaborations. Consistent with our theoretical arguments, tactics that threaten greater and more immediate material damage, or contention on issues material to firm performance, are most effective at driving green innovation. Moreover, supplementary analyses suggest contentious private politics is positively associated with risk perceptions of firms' leaders, which is in turn, correlated with green innovation. While collaborations with SMOs do not significantly influence the volume of green innovation, they are more effective at pushing firms in more novel directions in their innovation. This is consistent with the idea that firms access novel environmental expertise from outside stakeholders (i.e., SMOs) by collaborating with them directly and intensively, and therefore are better able to search for novel solutions unexplored by others. This finding also corresponds with research in knowledge and network structures where novel and complex knowledge is better produced within a direct and socially cohesive network (Reagans & McEvily, 2003; Rosenkopf & Almeida, 2003).

DISCUSSION

Scholars have documented myriad ways by which social activists engage firms to influence firms' strategic choices and outcomes, including location choices (Yue et al., 2013), entry into new industries (Lounsbury et al., 2003), and market returns (King, 2008). In this paper, we extend this burgeoning line of inquiry by examining the influence of activists' contentious attacks and collaborations with firms on an equally critical strategic choice: innovation. Our findings accord with a behavioral theory account of firm decision making in innovation (Greve, 2003). Specifically, contention from activists, which threatens firms with losses, catalyzes innovation on issues advocated by activists, while collaborations, which offer access to knowledge in distant domains, are more effective catalysts for novel innovation.

This paper contributes to research in social movements, stakeholder theory and innovation. To our knowledge, this is the first attempt to build a comparative account of the impacts of contentious and cooperative private politics in research on movements and markets. To date, research examining interactions between firms and activists almost uniformly treats private politics as a 'contentious politics' in which activists engage firms as challengers. Our study demonstrates how cooperative private politics offers alternate means by which activists can influence firms' practices. As institutional change is likely a product of both contestation and cooperation (den Hond & de Bakker, 2007), we believe this study represents an important first step in building a more complete account of activist repertoires in advancing progress on societal grand challenges like climate change (George et al., 2016). Future research could extend comparative accounts of private politics to other firm decisions important to institutional change including adopting off-the-shelf innovations, or controversial practices (Briscoe & Murphy, 2012).

We also seek to contribute to nascent literature integrating insights from behavioral theory to better understand how managers deal with stakeholders (Nason et al., 2018). In contrast to Nason et al.'s (2018) framework that links negative and positive stakeholder feedback to legitimacy and efficiency frames, we posit that stakeholders can prompt loss and gain frames depending on whether they employ a stick or carrot in their interactions with firms. We are not the first to suggest issue frames affects firms' search processes in sustainability (Hahn, Preuss, Pinkse, & Figge, 2014; Sharma, 2000). But we depart from this work which takes issue frames as given, or considers the role of internal issue framing (Howard-Grenville, Nelson, Earle, Haack, & Young, 2017), to consider how seemingly similar external stakeholders can trigger different issue frames by deploying different tactics against firms. An important limitation of our study is that we cannot observe managerial frames, nor how contention and collaboration may interact with managers' pre-existing frames around climate change. We believe both are important opportunities for future study.

Finally, this study offers new insights into nascent literature on how nonmarket stakeholders affect firms' innovation processes and outputs. While most research on firm innovation focuses on market stakeholders like customers or competitors, scholars have also noted that nonmarket stakeholders play a nontrivial role in innovation (Jia, Huang, & Zhang, 2019; Li, Xia, & Zajac, 2018). We contribute to this literature novel theory and empirical evidence on an entirely different but still consequential set of nonmarket stakeholders: social movements. We do so in the context of climate change innovation, where scholars have repeatedly documented the critical role of demand-side incentives, particularly from government, to overcome disincentives to private investment due to challenges to appropriating returns of public goods creation (King, 2007). We see opportunities for extension of the insights of this study into other innovation domains that produce public goods not entirely appropriable by firms, or those with negative externalities. Promising domains include artificial intelligence or facial recognition technology which can perpetuate gender and racial biases. Innovation has the potential to not only disrupt industries, but also societies. Understanding the role that social movements play in directing firm innovation into socially-beneficial areas, or those that mitigate negative social impacts, is critical.

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Table 1: Summary Statistics and Correlation Tables

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Green patents logged (DV)	0.942	1.216															
2. Novel green patents logged (DV)	0.723	1.080	0.962														
3. Contentious interactions	0.094	0.586	0.134	0.141													
4. Industry contentious interactions	0.439	1.780	0.107	0.117	0.542												
5. Intensive collaborations	0.112	0.486	-0.013	-0.018	-0.022	-0.009											
6. Contention on non-climate issues	0.453	1.260	0.143	0.158	0.267	0.265	-0.010										
7. Cooperative arms-length interactions	0.028	0.171	-0.019	-0.021	-0.001	0.001	0.323	0.008									
8. Interactive collaborations	0.009	0.143	-0.021	-0.025	-0.010	-0.015	0.060	-0.021	0.025								
9. Firm environmental performance	1.538	1.731	0.257	0.310	0.219	0.200	-0.079	0.402	-0.011	-0.053							
10. Issue materiality	0.637	0.481	0.144	0.139	0.076	0.073	-0.002	0.049	-0.021	-0.030	0.171						
11. Firm public approval	0.274	0.553	-0.029	-0.018	-0.033	0.003	0.010	0.001	0.001	0.018	0.003	-0.012					
12. Firm assets, logged	10.022	0.992	0.208	0.196	0.225	0.167	0.075	0.353	0.100	0.043	0.359	-0.059	-0.067				
13. Firm return on assets	0.059	0.104	0.055	0.046	0.052	0.050	0.073	0.074	0.045	0.018	0.032	-0.091	-0.009	0.134			
14. Firm market leverage	0.195	0.168	-0.127	-0.124	-0.087	-0.073	-0.085	-0.118	-0.061	0.015	-0.026	0.242	0.091	-0.345	-0.538		
15. Firm slack resources	1.486	0.642	-0.050	-0.080	-0.057	-0.082	0.049	-0.139	0.001	0.020	-0.300	-0.116	-0.109	-0.181	0.181	-0.245	
16. Firm R&D intensity	0.046	0.061	0.000	-0.018	-0.080	-0.085	0.179	-0.158	0.025	0.029	-0.201	-0.299	0.004	0.077	0.051	-0.222	0.314
17. Firm patent stock	6.175	1.674	0.378	0.348	0.047	0.004	0.124	0.069	0.029	0.073	0.191	-0.124	-0.058	0.382	0.208	-0.348	0.120
18. Firm patent quality	4.941	1.791	0.376	0.344	0.036	-0.019	0.124	0.011	0.020	0.051	0.056	-0.166	-0.090	0.301	0.171	-0.408	0.127
19. Firm technological diversity	0.873	0.174	0.207	0.184	0.053	0.064	-0.021	0.093	0.036	0.020	0.266	0.077	0.025	0.378	-0.035	-0.010	-0.216
20. Industry technological opportunity	10.265	1.278	0.292	0.236	0.002	-0.051	0.111	-0.023	0.049	0.068	-0.019	-0.053	-0.015	0.368	0.035	-0.195	0.069
21. Ratio of multiple-issue green patents	0.191	0.333	0.174	0.168	0.166	0.174	-0.023	0.066	0.005	-0.010	0.204	0.063	-0.080	0.086	0.022	-0.036	-0.011
22. State-level solar energy policy	1.228	0.913	-0.009	-0.050	0.054	0.058	0.066	-0.039	0.019	0.051	-0.201	-0.170	-0.052	0.096	0.025	-0.100	0.109
23. Congressional hearings on the issue	9.829	11.599	-0.012	-0.040	0.126	0.227	0.111	-0.017	0.115	0.034	-0.095	-0.171	-0.008	0.114	0.041	-0.060	0.024

Variable	16	17	18	19	20	21	22
17. Firm patent stock	0.441						
18. Firm patent quality	0.419	0.796					
19. Firm technological diversity	-0.060	0.395	0.307				
20. Industry technological opportunity	0.281	0.713	0.637	0.530			
21. Ratio of multiple-issue green patents	-0.050	0.119	0.089	0.132	0.080		
22. State-level solar energy policy	0.231	0.130	0.153	0.034	0.211	-0.023	
23. Congressional hearings on the issue	0.057	-0.031	-0.125	-0.039	0.051	0.064	0.074

Note: N=1,169 corresponding to the coarsened exact matching model.

Table 2: Effects of Firm-SMO Contentious Interactions and Collaborations on Firms' Green Innovation

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	DV: log (#) of green patents				DV: log (#) of novel green patents			
Contentious interactions		0.121**		0.072**		0.031		0.024
		(0.037)		(0.026)		(0.019)		(0.02)
Industry contentious interactions			0.053**	0.040*			0.011	0.007
			(0.017)	(0.018)			(0.01)	(0.012)
Intensive collaborations		0.124	0.125	0.129		0.117*	0.117*	0.118*
		(0.079)	(0.079)	(0.079)		(0.049)	(0.05)	(0.05)
Contention on non-climate issues	-0.005	-0.015	-0.012	-0.016	0.009	0.006	0.007	0.006
	(0.012)	(0.011)	(0.011)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)
Cooperative arms-length interactions	0.050	-0.035	-0.018	-0.023	-0.028	-0.113	-0.11	-0.112
	(0.157)	(0.173)	(0.172)	(0.174)	(0.104)	(0.096)	(0.095)	(0.096)
Interactive collaborations	-0.045	-0.039	-0.037	-0.038	-0.047	-0.041	-0.041	-0.041
	(0.059)	(0.059)	(0.057)	(0.058)	(0.057)	(0.057)	(0.057)	(0.057)
Firm environmental performance	-0.002	0.005	0.006	0.005	-0.064	-0.054	-0.053	-0.054
	(0.059)	(0.059)	(0.059)	(0.060)	(0.061)	(0.059)	(0.059)	(0.06)
Issue materiality	0.450**	0.404**	0.368*	0.363*	0.076	0.063	0.058	0.057
	(0.158)	(0.152)	(0.165)	(0.163)	(0.061)	(0.062)	(0.07)	(0.069)
Firm public approval	0.024	0.022	0.005	0.012	0.094*	0.086*	0.082+	0.084*
	(0.041)	(0.038)	(0.040)	(0.040)	(0.046)	(0.042)	(0.043)	(0.042)
Firm assets, logged	-0.071	-0.024	-0.031	-0.026	-0.165	-0.126	-0.127	-0.126
	(0.090)	(0.095)	(0.093)	(0.094)	(0.109)	(0.1)	(0.099)	(0.01)
Firm return on assets	0.009	-0.054	0.020	-0.005	-0.216	-0.27	-0.254	-0.263
	(0.470)	(0.485)	(0.476)	(0.481)	(0.319)	(0.314)	(0.307)	(0.314)
Firm market leverage	-0.713	-0.925	-0.738	-0.820	-0.181	-0.331	-0.287	-0.316
	(0.571)	(0.577)	(0.605)	(0.592)	(0.428)	(0.406)	(0.416)	(0.407)
Firm slack resources	-0.135+	-0.141+	-0.131+	-0.137+	-0.078	-0.078	-0.076	-0.078
	(0.080)	(0.076)	(0.079)	(0.077)	(0.077)	(0.074)	(0.073)	(0.074)
Firm R&D intensity	-0.640	-0.938	-0.709	-0.833	0.359	0.188	0.243	0.201
	(1.255)	(1.266)	(1.248)	(1.253)	(0.95)	(0.9)	(0.893)	(0.899)
Firm patent stock	0.323*	0.300*	0.317*	0.307*	0.138	0.128	0.132	0.129
	(0.128)	(0.125)	(0.125)	(0.126)	(0.161)	(0.158)	(0.158)	(0.159)
Firm patent quality	-0.038	-0.046	-0.051	-0.050	-0.007	-0.016	-0.017	-0.017
	(0.072)	(0.075)	(0.080)	(0.078)	(0.078)	(0.078)	(0.08)	(0.079)
Firm technological diversity	-0.735	-0.856	-0.813	-0.796	0.461	0.269	0.273	0.278
	(1.016)	(0.982)	(0.976)	(0.967)	(0.804)	(0.803)	(0.794)	(0.794)
Industry technological opportunity	-0.030	-0.001	-0.018	-0.008	-0.236**	-0.217**	-0.222**	-0.218**
	(0.114)	(0.113)	(0.115)	(0.113)	(0.08)	(0.081)	(0.082)	(0.081)

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Table 2 Continued: Effects of Firm-SMO Contentious Interactions or Collaborations on Firms' Green Innovation

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	DV: log (#) of green patents				DV: log (#) of novel green patents			
Ln (#) of green patents (lagged)	0.043***	0.042***	0.042***	0.041***				
	(0.009)	(0.009)	(0.009)	(0.009)				
Ln (#) of novel green patents (lagged)					0.799***	0.787***	0.787***	0.785***
					(0.036)	(0.036)	(0.037)	(0.037)
Ratio of multiple-issue green patents	0.185+	0.168	0.178+	0.170+	-0.039	-0.042	-0.039	-0.041
	(0.105)	(0.104)	(0.010)	(0.101)	(0.081)	(0.077)	(0.076)	(0.076)
State-level solar energy policy	0.169*	0.183**	0.158*	0.170*	0.193**	0.194**	0.188**	0.192**
	(0.065)	(0.068)	(0.064)	(0.066)	(0.072)	(0.064)	(0.065)	(0.064)
Congressional hearings on the issue	0.002	0.002	-0.001	-0.001	0.002	0.002	0.002	0.002
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	0.301	-0.131	-0.004	-0.0991	3.003**	2.690**	2.724**	2.690**
	(1.257)	(1.294)	(1.320)	(1.294)	(0.992)	(0.934)	(0.939)	(0.936)
N	1169	1169	1169	1169	1169	1169	1169	1169
F-statistic	19.23	33.79	33.62	34.78	121.87	323.23	150.32	270.69
Adjusted R-squared	0.794	0.798	0.799	0.800	0.863	0.864	0.864	0.864

Note: Heteroskedasticity robust standard errors clustered at the firm level in the parentheses (results are robust to industry level clustering). All models include firm, issue and year *x* industry fixed effects.
+ p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table 3: Supplementary Analysis of Drivers of Firms' Green Innovation

	Model 9	Model 10	Model 11	Model 12
	DV: log (#) of green patents			
Contentious interactions	0.0618+	-0.403**		0.0679**
	(0.0342)	(0.145)		(0.0256)
Material contentious tactics	-0.189			
	(0.207)			
Contentious interactions x material contentious tactics	0.138*			
	(0.0672)			
Contentious interactions x issue materiality		0.492**		
		(0.154)		
Environmental risk (% of earnings call devoted to enviro. risk)			0.0260*	
			(0.0128)	
All risk (% of earnings call devoted to any risk)			0.000296	
			(0.00029)	
Industry contentious interactions	0.0307*	0.0400*	0.0443*	0.0371*
	(0.0133)	(0.0162)	(0.0203)	(0.0154)
Intensive collaborations	0.0729	0.136+	-0.00664	0.0665
	(0.0487)	(0.0801)	(0.0420)	(0.0528)
Contention on non-climate issues	-0.00942	-0.0172	-0.00321	-0.00788
	(0.0102)	(0.0107)	(0.0105)	(0.00786)
Cooperative arms-length interactions	-0.0937	-0.0170	-0.00719	-0.0899
	(0.126)	(0.182)	(0.0465)	(0.115)
Interactive collaborations	-0.0738	-0.0418	0.0167	-0.0102
	(0.0604)	(0.0596)	(0.0474)	(0.0562)
Firm environmental performance	-0.00539	-0.00366	0.0111	0.00521
	(0.0291)	(0.0603)	(0.0303)	(0.0356)
Issue materiality	0.206	0.319+	0.146	0.349*
	(0.149)	(0.172)	(0.103)	(0.142)
Firm public approval	-0.0212	0.0101	0.0112	-0.00716
	(0.0331)	(0.0388)	(0.0370)	(0.0249)
Firm assets, logged	0.0550	-0.0119	0.0263	0.0104
	(0.0780)	(0.0917)	(0.0507)	(0.0614)
Firm return on assets	-0.211	-0.117	-0.0651	-0.500+
	(0.233)	(0.468)	(0.208)	(0.267)
Firm market leverage	-0.0368	-0.930	-0.141	-0.360
	(0.258)	(0.595)	(0.197)	(0.309)
Firm slack resources	-0.00915	-0.133+	-0.0137	-0.0649
	(0.0370)	(0.0737)	(0.0355)	(0.0457)
Firm R&D intensity	-0.163	-0.575	0.0720	-0.299
	(0.885)	(1.295)	(0.413)	(1.078)

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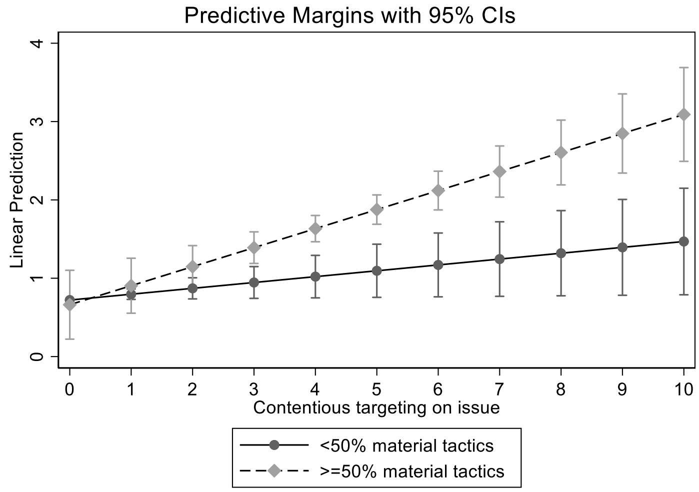
Table 3 Continued: Supplementary Analysis of Drivers of Firms' Green Innovation

	Model 9	Model 10	Model 11	Model 12
	DV: log (#) of green patents			
Firm patent stock	0.0763*	0.318*	0.0565*	0.129*
	(0.0378)	(0.124)	(0.0265)	(0.0640)
Firm patent quality	0.0318	-0.0556	0.0434*	-0.0209
	(0.0311)	(0.0782)	(0.0194)	(0.0410)
Firm technological diversity	-0.0298	-0.737	-0.149+	-0.532
	(0.463)	(0.960)	(0.0758)	(0.435)
Industry technological opportunity	0.168*	-0.000477	0.0837***	0.0920*
	(0.0773)	(0.114)	(0.0219)	(0.0439)
Ln (#) of green patents (lagged)	0.0337***	0.0409***	0.0348***	0.0402***
	(0.00849)	(0.00901)	(0.00984)	(0.00835)
Ratio of multiple-issue green patents	0.121	0.162	0.307**	0.146+
	(0.0915)	(0.0983)	(0.0948)	(0.0759)
State-level solar energy policy	0.00218	0.168*	0.0103	0.00296
	(0.0460)	(0.0669)	(0.0207)	(0.0484)
Congressional hearings on the issue	-0.0000793	-0.00140	-0.000812	
	(0.00245)	(0.00452)	(0.00103)	
Constant	-2.269*	-0.331	-1.265+	-0.665
	(0.974)	(1.315)	(0.640)	(0.691)
N	1169	1169	1169	1169
F-statistic	36.41	35.68	24.70	25.56
Adjusted R-squared	0.755	0.803	0.707	0.816

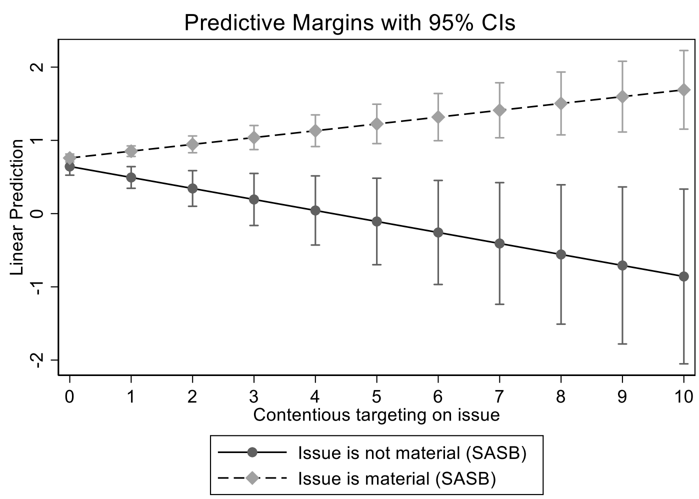
Note: Heteroskedasticity robust standard errors clustered at the firm level in the parentheses (results are robust to industry level clustering). Models 9 through 11 include firm, issue and year x industry fixed effects. Model 12 shows results are robust to issue x year fixed effects, in addition to firm and industry fixed effects.
+ p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Figure 1: Green innovation and contentious targeting by the degree to which contention disproportionally involves material tactics (i.e., lawsuits, regulatory interventions, shareholder resolutions)



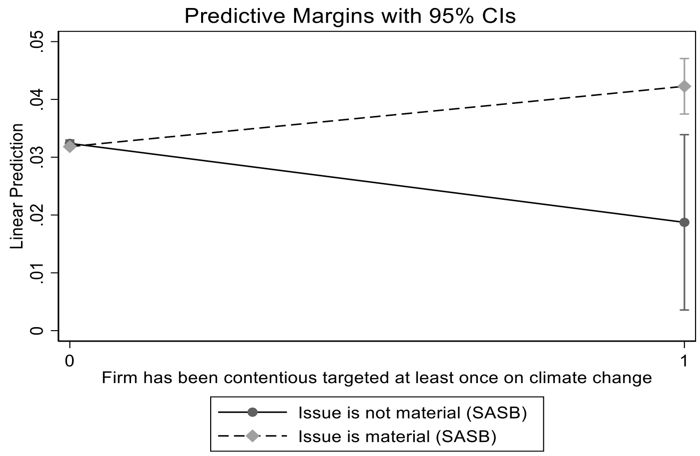
Note: Figure 1 plots the marginal effects of Model 9 on green innovation, where we use a dummy variable to denote contention against the firm involves materials tactics including lawsuits, legal interventions, shareholder resolutions, more than 50% of the time.

Figure 2: Green innovation and contentious targeting by whether the environmental issue is material or not to the firm



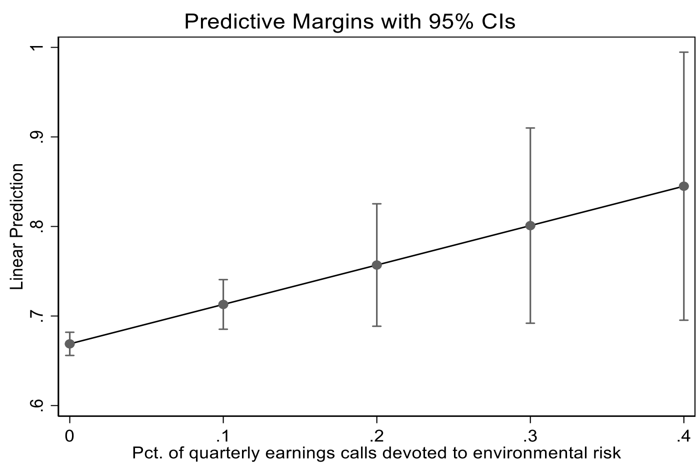
Note: Figure 2 plots the marginal effects of Model 10 on green innovation, where we use a dummy variable to denote whether the environmental issue is material to the firm based on SASB's classification of material issues.

Figure 3: Contentious targeting of firm on material and nonmaterial issues and the percentage of earnings calls devoted to environmental risks



Note: Figure 3 plots the marginal effects of firms contentiously targeted at least once on material and nonmaterial issues on the percentage of earnings calls those firms devote to environmental risks the following year. The regression model is identical to that employed in our main estimates, including all controls and fixed effects.

Figure 4: Green innovation and the percentage of earnings calls devoted to environmental risks



Note: Figure 4 plots the marginal effects of Model 11 where we regress green innovation on the percentage of earnings calls devoted to environmental risks.