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Are R&D-Intensive firms also corporate social responsibility specialists? A multicountry study

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ABSTRACT

Seeking to obtain efficiency in the development and integration of knowledge about R&D and corporate social responsibility (CSR), firms face hard choices about their resource allocation to these two areas because of the specialized nature of knowledge and related barriers to integration. We address this organizational resource allocation dilemma by relaxing the common assumption that firms are either responsible or irresponsible and examining financial slack as a possible moderator. Using a multicountry sample of 1,957 firms over a 16-year timespan, we find strong empirical support for the positive association between firms' R&D intensity and CSR specialization, a novel concept that—distinct from CSR as such—gauges the extent to which firms specialize in specific environmental, social, or governance aspects of CSR. However, there is insufficient support for financial slack as a moderator in general (except for one noteworthy industry pattern and an alternative operationalization of slack). The exceptions suggest that the nature of organizational slack may influence the relationship between R&D and CSR specialization.

1. Introduction

Large companies must appease a multitude of stakeholders by investing in corporate social responsibility (CSR) while developing new knowledge and implementing innovations. R&D-intensive pharmaceutical firms, for example, often need to balance the prioritization of medical R&D and a broader set of stakeholder pressures. As a result, some companies (e.g., Sanofi) had to cut their CSR because of the felt need to shift their spending to the development of new products (IFPMA, 2017; Upton, 2017). Other companies, such as Takeda, seem to have been able to exploit synergies between CSR and R&D by sharing expertise, know-how, and technologies to meet their economic and societal goals (IFPMA, 2017; Upton, 2017).

The academic debate mirrors this practitioner dilemma. Several studies suggest that R&D and CSR can create organizational synergies (Antonioli et al., 2013; Borghesi et al., 2015; Kesidou and Demirel, 2012; Padgett and Galan, 2010). Yet, this view has also been contested by the claim that both activities also compete for scarce resources and managerial attention (Hull and Rothenberg, 2008; McWilliams and Siegel, 2000; Mithani, 2017). This unresolved debate motivates our study because a meaningful investigation of R&D and CSR relies on exploring synergies and tradeoffs as two coexisting yet opposing latent mechanisms driving the complex relationship between R&D and CSR.

Because decisions about R&D and CSR can affect stakeholder relationships, organizational reputation, and profitability, the R&D–CSR tradeoff, or synergy, has wide-ranging strategic implications. In this study, we empirically demonstrate that firms may be able to reconcile the tradeoff between R&D and CSR—by focusing on specific CSR dimensions while neglecting others. Thus, R&D-intensive firms that adopt a tradeoff mindset between R&D and CSR may, for example, specialize in a particular aspect of CSR, such as ecological sustainability, and invest few, if any, resources in other areas, such as ethical governance. Accordingly, we need to relax the assumption that CSR is a unitary concept and that firms are either responsible or irresponsible; rather, firms can be both at the same time (Fu et al., 2019; Strike et al., 2006; Surroca et al., 2013; Wang and Choi, 2013). There is within-firm variability in how much they specialize—or not (i.e., CSR generalists)—in particular aspects of CSR (Capelle-Blancard and Petit, 2017).

Drawing on the knowledge-based view (KBV) and building on previous studies of the R&D–CSR relationship (Grant, 1996; Hull and Rothenberg, 2008; McWilliams and Siegel, 2000; Surroca et al., 2010), we explicitly focus on the critical role of R&D intensity as a driver of CSR specialization. We postulate a positive association between R&D

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and specialization in CSR as our first hypothesis: firms that are high in R&D intensity (R&D expenditures/revenues) specialize in specific aspects of CSR because R&D and CSR essentially compete for firm resources. Prior research suggests that firms' R&D and CSR are both subject to generic constraints on firm resources (Campbell, 2007; Surroca et al., 2010), so we further ask: How does the R&D–CSR relationship change under conditions of economic resource constraints? Thus, we address the role of slack resources as a key contingency, either mitigating or exacerbating resource constraints (Voss et al., 2008; Wang et al., 2016). In sum, using a multilevel panel data set, we investigate the following research questions: *(1) How does a firm's R&D intensity reinforce organizational decisions about becoming CSR specialists? (2) How does a firm's financial slack moderate the R&D intensity–CSR specialization relationship?*

It is important to note that our dependent variable is not CSR per se, but instead CSR specialization, a heterogeneity construct (Harrison and Klein, 2007). Specifically, the dependent variable in this study reflects the within-firm heterogeneity, at a given point in time, with respect to its CSR activities, which are also known as ESG practices—environmental (E), social (S), and governance (G) (Ioannou and Serafeim, 2012; Luo et al., 2015). The internal disparity in CSR is assumed to be continuous and ranges from firms exhibiting low disparity at one end (i.e., CSR generalists that are low or high in all or almost all ESG dimensions) to those showing high disparity at the other (i.e., CSR specialists narrow the scope of CSR to one particular ESG practice) (see also Harrison and Klein, 2007; Wang and Choi, 2013).

This study makes two major contributions to the literature. First, transcending previous views of CSR as a monolithic concept (Hull and Rothenberg, 2008; McWilliams and Siegel, 2000; Surroca et al., 2010), we suggest R&D and CSR can be both competing and synergistic at the same time—but with respect to *different* CSR dimensions or stakeholder groups. Thus, unlike prior research, our study does not conceptualize R&D as *either* a contributing factor *or* impediment for CSR (e.g., Antonioli et al., 2013; Boehe and Barin-Cruz, 2010; Mithani, 2017). This has far-reaching implications for theory and practice of organizational knowledge development/integration. Second, we examine the impact of resource constraints and industry patterns more broadly as contingency factors of the complex relationships and dynamics between R&D intensity and CSR specialization.

The paper is organized as follows. Extending the knowledge-based view (KBV) of the firm to the R&*D* − CSR relationship, we describe the theoretical mechanisms that may create either synergies or tradeoffs between R&D and CSR in the following section. From this knowledge-based theorizing we derive two hypotheses. In the Results section, hypothesis tests are followed by a series of post hoc analyses, robustness checks, and a natural experiment study design to clarify the causal direction. We conclude with several implications for research and recommendations for practitioners.

2. Theoretical background and hypotheses

As already mentioned, our explicandum is CSR specialization, and we are interested in the question of how and why R&D intensity, a firm's spending on R&D as a proportion of its output, affects organizational decisions about becoming either specialists or generalists in their CSR investments. Explaining the relationship between R&D intensity and CSR specialization requires a deeper understanding of how organizational innovation processes may reinforce or support specialized knowledge in CSR. In line with this thinking, our theoretical foundation, the knowledge-based view (KBV), assumes that firms exist to integrate specialized knowledge across employees and functional areas (Grant, 1996).

In a broader theoretical context, "the provision of CSR will depend on R&D spending" (McWilliams and Siegel, 2001, p.125). Drawing on a theory of the firm perspective, these economists argue that CSR is driven by stakeholder demand and supply factors: demand for products differentiated by social and environmentally sustainable attributes often requires R&D in the form of product and process developments, which, in turn, relies on the supply of resources, such as equipment, inputs from suppliers, human resources, and specialized knowledge. McWilliams and Siegel (2000, p. 608) also showed empirically that "R&D investment and CSR are likely to be highly correlated because both are associated with product and process innovation."

Additional research has more broadly supported the possible synergies between innovation and CSR (e.g., Padgett and Galan, 2010; Surroca et al., 2010). However, in relation to these potential synergies, the KBV points to a paradox. On the one hand, the KBV, which may be considered an extension of resource-based theory (Grant, 1996), suggests that coordinating and integrating specialized knowledge can create synergies between R&D and CSR. On the other hand, the very nature of firm knowledge being highly specialized makes the application of specific knowledge to different areas problematic. As we will explain in more detail below, it is precisely this paradox, inherent in the KBV, that may deepen our understanding of the R&D intensity–CSR specialization relationship.

2.1. Synergistic knowledge development

The KBV assumes that firms exist because they have the capacity to integrate specialized knowledge of multiple employees and to apply such knowledge to providing products and services (Grant, 1996; Zahra et al., 2020). Thus, coordinating and integrating specialist knowledge represents a central task of any firm. Knowledge relatedness—the extent to which a firm uses common knowledge across business units—can lead to synergies or economies of scope (Tanriverdi and Venkatraman, 2005).[1] In our context, knowledge relatedness occurs if the two areas of R&D and CSR share relevant knowledge, such as knowledge about key stakeholders of the firm and their demands. Customers, for instance, may demand new product features that are also environmentally sustainable; hence, knowledge on customer preferences can feed into product development and in the design and implementation of CSR strategies. Software development knowledge can be combined with in-depth knowledge of social challenges leading to new software applications that promote education and skill development in disadvantaged communities, such as Twitter's "Neighbor Nest" program (Ramanathan, 2016).

Extending the work by Tanriverdi and Venkatraman (2005) to the context of R&D and CSR, knowledge-related synergies can arise from two mechanisms. First, the overall cost of knowledge, which is time-consuming and expensive to accumulate, can diminish because similar knowledge can serve as an input for both R&D and CSR. Second, knowledge can also create value for different stakeholders with similar interests, for example, customers, investors, and the general public may all place high value on new technologies for emissions reduction. Likewise, knowledge used to address different interests of the same stakeholder (e.g., employees seeking healthier working conditions, lower risks of losing their jobs, a less stressful working environment, and more transparency in corporate decision making) can spur new process developments that also improve working conditions and thus eventually lead to higher corporate social performance—defined as the observable outcome of CSR principles and organizational processes (Orlitzky et al., 2003; Wood, 1991).

Because synergistic combinations of R&D and CSR activities may result in specific, heterogeneous resources and capability bundles over time, they may also be difficult to imitate and thus enhance the firm's competitive advantage (Branco and Rodrigues, 2006; McWilliams and Siegel, 2001): "the broader the scope of the knowledge integrated

[1] Notably, our study does not investigate the implications of these potential synergies for organizational performance (outcome). Rather, our empirical focus is on R&D as a factor driving CSR specialization.

within a capability, then the more difficult imitation becomes" (Grant, 1996: 117). Integrating and combining R&D and CSR knowledge can create socially complex and causally ambiguous combinations that make imitation by rivals less likely (Barney, 1991). For this reason, purposeful managerial decisions with respect to developing synergies between R&D and CSR may lead to relatively high complexity of broad-scale integration of organizational knowledge and, thereby, create strategic value for their firm.

For instance, product development can shift emphasis to eco-innovations, that is, new or improved products with strong environmental performance (Kesidou and Demirel, 2012). New process development or process improvements with the aim of reducing energy inputs, waste, or emissions, and providing healthier or safer working conditions constitute a further approach to creating synergy between R&D and CSR. Firms can reduce their costs and/or differentiate themselves as responsible employers and good corporate citizens through such process innovations (Orsato, 2006). Related research has also provided evidence for synergies between R&D, training, and environmental innovations (Antonioli et al., 2013; Borghesi et al., 2015). Such synergies between R&D and CSR are not limited to environmental process innovations, as research on social innovations has demonstrated (van der Have and Rubalcaba, 2016).

2.2. Tradeoffs

Despite these complementarities in investments in R&D and CSR, firms also face tradeoffs in developing new firm-specific knowledge because of resource constraints. Because internal knowledge development for both R&D and CSR is a time-consuming process, there is internal competition for resources. For example, the development of firm-specific knowledge (e.g., R&D) requires formal training or fairly extensive experience in working with firm-specific complementary assets, such as proprietary software, equipment, or other employees' knowledge, among others. Also, generating knowledge in CSR requires interaction with stakeholders and an in-depth understanding of firm-specific stakeholder demands and CSR issues (Barnett, 2007). Gaining such firm-specific experience is often time-consuming and poorly incentivized (Penrose, 1959; Raffiee and Coff, 2016). To solve this dilemma, the KBV emphasizes the firm's capacity to coordinate and integrate firm-specific knowledge that is firm-internal (Lazear, 2009; Wang et al., 2016) and of limited value outside the focal firm because of its dependence on complementary assets (Coff and Raffiee, 2015).

Arguably even more important, such strategic knowledge resources are not tradable to a large extent (i.e., they cannot be easily bought and sold in a market) because of the information paradox (Arrow, 1971): markets for knowledge fail because a purchaser of knowledge can only know that the knowledge is valuable once its content has been revealed; once revealed, however, the purchaser does not have any incentive to pay for the knowledge anymore. Likewise, a firm's knowledge in its firm-specific CSR cannot just be purchased in a market. This further explains why firm-specific knowledge needs to be created through time-consuming internal processes. If the availability of specific knowledge is limited by the speed at which firms can produce knowledge internally, then it follows that different areas within the firm compete for resources that help produce such knowledge.

Apart from these limits on the internal *development* of organizational knowledge, firms also face constraints in coordinating knowledge *application*. Consistent with the KBV, knowledge application relies on managers' cognitive abilities and their decision-making autonomy. Allocating their attention across a range of different activities can exceed managers' cognitive abilities (Cyert and March 1963; Simon, 1947). Even after recruiting new managers, firms are generally unable to allocate them immediately to complex tasks because of the time-consuming nature of firm- or product-specific induction (Penrose, 1959). Given these cognitive and resource constraints, more tangential CSR may be neglected in the face of more pressing or high-stake investments, such as R&D (Mithani, 2017).

Finally, the coordination of knowledge allocation and the integration of related knowledge are impeded by the nature of employment contracts, which tend to be vague regarding the ownership rights of individual employees' knowledge (Grant, 1996). Constraints on the development and application of internal knowledge imply that firms face hard choices as to the area where internal knowledge development and deployment should occur primarily–R&D or CSR. These constraints on the coordination and integration of knowledge imply that the beforementioned synergies are, in fact, limited and that firms face real tradeoffs between R&D and CSR (Fu et al., 2019).

These theoretical conjectures tend to be supported by empirical research on resource constraints on R&D and CSR. For example, Brown and Krull (2008) show that resource constraints can result in decreasing R&D expenditures. Competitors' entries into a firm's market can result in lower profitability and a therefore in a reduction of R&D spending (Czarnitzki et al., 2008). Similarly, Campbell (2007) has argued that firms under resource constraints spend less on CSR. Strike et al. (2006) and Surroca et al. (2013) provide empirical evidence for the argument that firms under stakeholder pressure adopt irresponsible practices in some markets. Exogenous economic pressures, such as crises, can make resource constraints particularly pertinent (Bansal et al., 2015; Barnett et al., 2015). For example, in 2017, Sanofi, a pharmaceutical firm, had to pull out of its Zika vaccine partnership with a nongovernmental organization (NGO) on a community health program because the social partnership stretched the financial and managerial resources available for R&D activities (see Upton, 2017).

In sum, resource constraints increase organizational pressures to choose between R&D and CSR. However, the aforementioned synergies between R&D and CSR do not simply disappear in the presence of tradeoffs. Therefore, encountering openly opposing arguments, we cannot easily determine to what extent R&D and CSR are synergistic or competing. However, we argue that this controversy can be reconciled by showing that R&D-intensive firms tend to specialize in specific CSR actions.

2.3. Why R&D intensity increases CSR specialization

As we explained above, R&D intensity may compete with CSR because both require significant resource commitments. However, competition for resources does not eliminate the potential synergies between R&D and CSR. If synergies between R&D and CSR remain important, then how do firms resolve this dilemma? We suggest that firms respond to this dilemma by focusing on specific dimensions of CSR (CSR specialization), while avoiding broader, generalized commitments to CSR, for the following reasons.

First, R&D intensity can persistently drive CSR specialization because innovation activities are highly path dependent and accumulative in nature (Nelson and Winter, 1982), probably more so than any other firm activity. This path dependence creates self-reinforcing mechanisms that limit the organizational scope of action (Sydow et al., 2009). Path dependence in R&D implies that other functional areas and activities such as CSR end up adjusting to R&D activities rather than affecting the scope of R&D. In the case that R&D exploits synergies with CSR, the potential of such synergies would be as narrowly scoped as the limited scope of R&D itself. This would make CSR specialization more likely.

Second, R&D activities generally require significant investments in fixed assets (e.g., laboratories, equipment) as well as time-consuming training and capability building (García-Quevedo et al., 2014). CSR, in contrast, requires significantly lower investments in fixed assets and specialized training, which makes such investments also easier to reverse. Hence, accumulated investments in R&D tend to affect CSR (rather than the other way around) and thus reinforce above-mentioned effects of path-dependence in innovation activities, further contributing to a narrowing scope in CSR.

Third, leveraging the behavioral dimension of the KBV, an important reason for firms high in R&D intensity adopting a narrower scope in CSR is that integrating specific knowledge faces a range of barriers, such as cognitive (Cyert and March 1963; Simon, 1947) and contractual limits. Therefore, transferring knowledge between areas (e.g., from R&D to CSR, or vice versa) is costly and therefore undertaken only to a limited extent (Jensen and Heckling, 1995). Consequently, synergies between R&D and CSR would be limited to a specific area. In other words, trying to integrate several areas of CSR with R&D would overstretch the firm's managerial coordination capacity (Kamuriwo and Baden-Fuller, 2016; Zahra et al., 2020). Moreover, firms need to target a specific area if they intend to create synergies between R&D and CSR because the expected overall cost reduction or value creation (discussed earlier; see Tanriverdi and Venkatraman, 2005) would be unlikely to materialize if synergies were compensated by exacerbating coordination costs. Therefore, we hypothesize:

Hypothesis 1. *There is a positive association between R&D intensity and CSR specialization.*

Notably, previous research suggests that organizational decisions about R&D and CSR may be mutually dependent (Berrone et al., 2013; Fernández-Kranz and Santaló, 2010). Although we focus on a different relationship (R&D intensity–CSR specialization), we aim to test the possible causal relationship not only via multilevel regression models, but also a natural experiment.

2.4. How slack resources enhance synergies and counteract tradeoffs

Firms with more slack resources are expected to suffer less from tradeoffs because they enjoy the “luxury” of developing knowledge on R&D while simultaneously addressing a broad range of stakeholders. Organizational slack resources are spare resources available in excess of the actual resource demands and commitments within a particular period, which allow firms to adapt to internal or external pressures (Bourgeois, 1981; Vanacker et al., 2017; Wang et al., 2016). Although slack resources can be classified into different types (financial, human resources, consumer relational, operational), we focus on financial slack resources because, being generic and not representing any particular stakeholder (Voss et al., 2008), they are fungible, that is, they can easily be allocated to different activities, including to knowledge development and allocation across R&D and CSR.

It is important to note that slack resources can be used to (a) enhance synergies and/or (b) mitigate tradeoffs. First, to enhance synergies, firms can use their financial slack to increase knowledge relatedness between R&D and CSR (Tanriverdi and Venkatraman, 2005). Namely, slack can help firms accumulate complementary knowledge needed to leverage existing knowledge such that it becomes applicable to different areas. For instance, spending slack resources, knowledge about customer preferences for new product development can be enhanced. Such knowledge is important to understand under what conditions customers would purchase products that are more socially or environmentally sustainable. Likewise, firms can spend slack resources on improving a firm's coordination capacity (e.g., by investing in liaison personnel or knowledge management systems) in such a way that knowledge from several areas, including R&D and CSR, could be integrated more effectively and efficiently. Second, slack resources may be able to mitigate tradeoffs between R&D and CSR because slack resources will allow the firm to address the concerns of a broad set of stakeholders (Surroca et al., 2010), even under intense pressures from competitors and customers when firms are forced to maintain or raise R&D investments (Jeong and Kim, 2019).

Indeed, previous research has shown that financial slack encourages risk taking and long-term projects (Voss et al., 2008). Several studies have suggested that knowledge-based activities that provide long-term strategic benefits, such as R&D and CSR, can benefit from the availability of financial slack resources (Brammer and Millington, 2008; George, 2005; Voss et al., 2008). Extending this rationale to our field of inquiry, we would expect that financial slack alleviates the tradeoff between R&D and CSR; in other words, firms with higher financial slack would be able to have high R&D intensity and a broader scope in their CSR at the same time.

Hypothesis 2. *Financial slack negatively moderates the association between R&D and CSR specialization, such that the higher an organization's slack, the weaker the link between R&D intensity and CSR specialization.*

3. Methods

3.1. Data sources and sample

We arrived at the final sample in a five-step process. First, we identified firms in *ASSET4ESG* that had complete data on selected ESG practices. The detailed ESG indicators used in this study are displayed in Table A1 of the Appendix. *ASSET4ESG* includes more than 6000 global companies whose shares comprise various stock indices, including *S&P 500, NASDAQ 100, MSCI World, STOXX600, Russell 1000, FTSE 100, ASX 300,* and *MSCI Emerging Market* (Thomson Reuters, 2012). Our database extends from 2002 to 2017 and includes 67,452 firm-year observations based on a sample of 6803 companies. Second, we collect accounting data, including employee numbers, R&D expenditures, and sales from *WorldScope* and *OSIRIS*. Third, we use country-level data on market openness, gross domestic product (GDP), and quality of regulations from the World Bank and Heritage Foundation. Fourth, we excluded start-ups from our analysis because many start-ups are characterized by extremely high R&D intensity ratios (Criscuolo et al., 2012). We identified these start-ups (150 firms, 377 firm-year observations) by using two criteria: (a) the firm is less than 5 years old and (b) the firm is classified as small or medium-sized business (i.e., has fewer than 250 employees). On average, these start-ups' R&D intensity is 31.11%, which is more than three standard deviations over the average R&D intensity. Due to missing R&D expenditure data and the exclusion of start-ups, we arrived at an unbalanced panel of 1957 firms from 2002 to 2017 with 13,257 firm-year observations, headquartered in 44 countries, predominantly based in the USA (34.92%) and Japan (24.03%). The sample is distributed across 10 sectors (listed in descending order): Industrials (28.66%), Consumer Discretionary (18.10%), Technology (14.96%), Basic Materials (13.30%), Health Care (9.65%), Telecommunications (4.25%), Financials (1.12%), Consumer Staples (0.48%), Utilities (0.28%), and Real Estate (0.22%). A more detailed distribution of firms across all 44 countries is available in Table A4 of the Appendix.

3.2. Dependent variable: CSR specialization

We used the coefficient of variation to measure CSR specialization (see Wang and Choi, 2013). Drawing on Harrison and Klein's (2007) conceptualization of disparity measures of heterogeneity, the coefficient of variation adjusts for the mean level of overall corporate social performance (i.e., an organization's CSR rated at a specific point in time) and enables researchers to study the within-unit dispersion (Harrison and Klein, 2007; Sørensen, 2002). This is crucial in our context because the coefficient of variation measures the dispersion or, alternatively, the focus of a firm's ESG scores around its overall corporate social performance. To obtain the coefficient of variation, we first calculated the firm's social performance on each of the three ESG dimensions. Then, we calculated the standard deviation (*SD*) of the performance on E, S, and G. Finally, we divided the *SD* by the mean of the three dimensions (Harrison and Klein, 2007).

The formula we use for the calculation of CSR specialization is as follows:

$$\text{CSR Specialization} = \frac{\sqrt{\frac{((E_{it} - ESG_{\mu it})^2 + (S_{it} - ESG_{\mu it})^2 + (G_{it} - ESG_{\mu it})^2)}{3}}}{ESG_{\mu it}}$$

where E_{it}, S_{it}, and G_{it} are the environmental, social and governance performance respectively, for firm (*i*) in year (*t*). $ESG_{\mu t}$ is the average ESG score of firm (*i*) in year (*t*).[2] This implies that CSR specialization is bounded by 0 and $\sqrt{n-1}$ (Harrison and Klein, 2007), where n denotes the total number of dimensions (3 in our case). Thus, the upper limit is $\sqrt{3-1} = 1.414$, indicating complete specialization, which is reached when a firm has a full score (i.e., 100) in one ESG dimension while 0 in others. In contrast, the lower bound signifies total equality, that is, a firm exhibits identical performance across E, S, and G dimensions. Increasing coefficients of variation reflect increasing levels of firm specialization in CSR.

3.3. Independent and moderator variables

3.3.1. R&D intensity

In line with generally accepted research practice (Berrone et al., 2013; Mudambi and Swift, 2014), we measured R&D intensity using the ratio of a firm's R&D expenditures to its total sales. R&D expenditures are an input measure of innovation and thus reflect learning-while-doing and knowledge resources (Knott, 2003). We winsorized R&D intensity by 2.5% at both ends in order to exclude those extreme values (typically some life science companies with no to little sales, but high R&D investment).

3.3.2. Financial slack

Financial slack provides firms with more resources to implement CSR (Campbell, 2007), which can be expected to reduce ESG heterogeneity. Our measure of slack is the widely used ratio of current assets to current liabilities (Bansal, 2005), although there are alternative measures, which we consider in our robustness checks.

3.3.3. R&D-intensive industries

We also created a dummy for R&D-intensive industries based on the OECD (2011) classification, coded "1″ for R&D-intensive industry and "0″ otherwise. These R&D-intensive industries are: Aerospace and Defense (ICBSC: 502010), Automobiles and Parts (ICBSC: 401010), Chemicals (ICBSC: 552,010), Industrial transportation (ICBSC: 502060), Medical equipment and Services (ICBSC: 201020), Pharmaceuticals and Biotechnology (ICBSC: 201030), Software and Computer Services (ICBSC:101010), Technology Hardware and Equipment (ICBSC: 101020), and Telecommunications Equipment (ICBSC:151010). The distribution of these industries in the overall sample is displayed in Table A1 in the Appendix. As Panel A of Table A3 in the Appendix shows, the *t* tests comparing industries with high and low average R&D intensity indicate that our scores of CSR specialization are significantly higher for R&D intensive industries than for the remainder of our dataset.

3.3.4. Consumer-facing industries

We also coded a dummy for consumer-facing industries (Lai et al., 2014) as "1″ and "0″ otherwise. These industries are: Financial Services (ICBSSC:3020), Food, Beverage and Tobacco (ICBSSC: 4510), Insurance (ICBSSC:3030), Personal Care, Drug and Grocery Stores (ICBSSC:4520), Retailers (ICBSSC: 4040), and Travel and Leisure (ICBSSC:4050). Non-consumer facing industries showed lower R&D intensity and CSR specialization than consumer-facing industries (see Panel B of Table A3 in the Appendix).

3.3.5. Heavily polluting industries

In line with the classification used by prior literature (e.g., Cainelli and Mazzanti, 2013; Dellachiesa and Myint, 2016), we coded heavily polluting industries as "1″ and "0″ otherwise. These highly polluting industries are: Chemicals (ICBSC: 552010), Construction and Materials (ICBSC: 501010), Conventional Electricity (through burning fossil fuels such as coal, petroleum and natural gas) (ICBSC:651010), General Industrials (ICBSC:502030), Industrial Materials (ICBSC: 551010), Industrial Metals and Mining (ICBSC: 551020), Non-Renewable Energy (Oil, Gas and Coal) (ICBIC:601010), and Precious Metals and Mining (ICBSC:551030). Table A2 in the Appendix shows the detailed distribution of all these industries in the sample. The *t* tests between heavily polluting industries and non-polluting industries indicate that heavily polluting industries have higher R&D intensity and CSR specialization than the remaining industries (see Panel C of Table A3 in the Appendix). We used these industry dummies in our post hoc analyses.

3.3.6. R&D tax incentives

In the context of a natural experiment design (see below), we used the OECD's Government Tax Relief for R&D expenditures (GTARD) as a percentage of Business Enterprise Expenditure on R&D (BERD).

3.4. Control variables

3.4.1. Stakeholder pressure

We controlled for stakeholder pressure because it can be a critical determinant of a firm's emphasis on specific ESG practices (Perez-Batres et al., 2012). We measured stakeholder pressure by calculating the overall mean of stakeholder pressures on the three different dimensions of ESG. We operationalized stakeholder pressure on each ESG dimension by employing *ASSET4* indicators that measure the number of controversies published in the media (press, TV, etc.) about a firm's impacts on the natural environment, society, and corporate governance (Capelle-Blancard and Petit, 2017; Surroca et al., 2013; Thomson Reuters, 2012).

3.4.2. Corporate social performance

In line with Wang & Choi's (2013) study, we controlled for firms' average level of corporate social performance because CSR specialization denotes within-firm focus, or distinctiveness, in ESG practices and, thus, does *not* reflect the (average) level of each firm's overall corporate social performance. Social performance is measured by the average of a firm's aggregate ESG scores.

3.4.3. Organization size

We measured firm size by the natural logarithm (*ln*) of a firm's number of employees (Surroca et al., 2010).

3.4.4. Return on assets

Return on assets (ROA) indicates to what extent a firm is able to extract profit from every dollar of assets at its disposal. Thus, ROA is a widely used proxy of organizational efficiency (e.g., Davis and Pett, 2002; Hamann et al., 2013). Because greater efficiency may predispose companies to be more specialized in their CSR, we included ROA as a control.

3.4.5. Industry concentration

Industry concentration, the inverse of industry rivalry, is also likely to affect CSR (Campbell, 2007; Flammer, 2015). The Herfindahl-Hirschman Index (HHI) is a commonly used measure of industry concentration: for each country and year, we calculated each firm's market share against the total sales of all the companies in their industry, defined at the four-digit Industry Classification Benchmark (ICB), and then we summed the squared market shares to obtain the HHI (Hirschman, 1964; U.S. Department of Justice, 2015). Because this

[2] All the ESG indicators used in the calculation are presented in Table A1 in the Appendix.

measure captures the effect of industry rivalry imperfectly, we used it merely as a control for effects not yet accounted for by other variables and our modeling approach (discussed below).

3.4.6. Market openness

To capture the effect of market forces on the R&D intensity–CSR specialization relationship, we used a composite measure of trade freedom, investment freedom, and financial freedom (*Heritage Foundation, Wall Street Journal*). We opted for this measure because we cannot measure external pressures on organizations–such as competitive rivalry– properly when competition in domestic markets is affected by trade, foreign direct investment (FDI), and other capital flows (e.g., international debt financing). As previous studies using this indicator have demonstrated, market openness also reflects a country's institutional framework associated with market efficiency (Fuentelsaz et al., 2015; Shinkle and McCann, 2014). The finance literature suggests that the validity and credibility of these economic freedom data are high (Chortareas et al., 2013). These indicators are scored on a scale from 0 (closed markets) to 100 (open markets for trade, FDI, and capital flows).

3.4.7. Quality of regulations

Beyond market openness, a broader range of regulatory institutions can affect CSR (Campbell, 2007; Surroca et al., 2013) and, thus, CSR specialization. We therefore used a composite measure of the six institutional governance indicators: (1) voice and accountability, (2) political stability and absence of violence, (3) government effectiveness, (4) regulatory quality, (5) rule of law, and (6) control of corruption. These indicators range from 2.5 (low) to 2.5 (high) and reflect the quality of market institutions (Kaufmann et al., 2016).

3.4.8. GDP

We included GDP from the World Bank database (in constant 2011 US dollars) in our model as control variable because the size of economy seems to be associated with CSR (See, 2009) and, therefore, possibly also CSR specialization. We used transformed GDP (by its natural logarithm) in our hypothesis tests.

3.5. Multilevel modeling

We tested our hypotheses using multilevel linear modeling (MLM) for both theoretical and empirical reasons. Theoretically, because different countries have different institutional environment, such as policies, regulations, and cultural norms for R&D activities and CSR activities (Ioannou and Serafeim, 2012; Matten and Moon, 2008). Therefore, it is important to consider country-level heterogeneity in our analysis. Thus, we applied MLM reflecting such heterogeneity and separating country-level variance from firm-level variance. Empirically, MLM has two major advantages over ordinary least squares (OLS) (Hofmann, 1997; Snijders and Bosker, 2012), particularly in a multicountry context. First, MLM recognizes that CSR and, thus, possibly also CSR specialization scores, tend to be similar for firms headquartered in a particular country for reasons related to the business environment (Ioannou and Serafeim, 2012; Orlitzky et al., 2017), which would violate the independence assumption of OLS. Thus, MLM accounts for the possible dependence of firms within a country by partitioning and modeling within-country and between-country variance simultaneously. Second, MLM allows to simultaneously investigate relationships between and across hierarchical levels, as well as within a particular hierarchical level (Raudenbush and Bryk, 2002). Because firm-level CSR specialization is expected to be associated with both firm-level predictors (e.g., firm-level R&D) and higher level predictors (e.g., country-level market openness), MLM is superior to OLS (Hofmann and Gavin, 1998; Raudenbush and Bryk, 2002).

Before proceeding with MLM, we needed to test whether the between-group (firm- and country-level) variance of the dependent variable is significantly different from zero (Raudenbush and Bryk, 2002; Snijders and Bosker, 2012). The intraclass correlation coefficient (ICC) of the null model indicates that 11.6% of the variance in CSR specialization is accounted for by country-level heterogeneity, which justifies using MLM (Hox, 2010; Peterson et al., 2012). Thus, a firm's CSR specialization can be explained by both firm-level and country-level variance. We lagged independent variables and all control variables and specified our model as follows (Raudenbush and Bryk, 2002; Snijders and Bosker, 2012):

$$\begin{aligned} CSR\ \ SPECIALIZATION_{ijt+1} = \beta_0 + \beta_1 R\&D_{ijt} + \beta_2 Financial\ \ Slack_{ijt} \\ + \beta_3 R\&D_{ijt} \times Financial\ \ Slack_{ijt} \\ + \beta_4 Controls + U_{jt} + \varepsilon_{ijt} \end{aligned}$$

$CSR\ \ SPECIALIZATION_{ijt+1}$ was measured for firm *i* in country *j* and in year $t + 1$. U_{jt} refers to country-specific effects (or random effects at the country level, see Table 3 "random effects") in year *t* that are unexplained by firm-level R&D intensity; and ε_{ijt} is the firm-specific error item that represents other factors that predict CSR specialization.

3.6. Natural experiment

To assess the causal relationship between R&D intensity and CSR specialization more fully, we identified a natural experiment to test whether or how government R&D tax incentives, an exogenous policy shock, may affect an organization's CSR specialization. In other words, testing the causality implied by our first hypothesis, we examined, in an experimental design, the change in firms' CSR specialization in response to exogenous sharp changes in government R&D policy, using a "difference-in-difference" (DID) estimator. A sharp policy shock in the external environment can provide the basis for a test of causality (Angrist and Pischke, 2008). Specifically, we identified such sharp exogenous policy shocks in a range of countries based on the OECD's governmental tax relief for R&D expenditures (as a percentage of a firm's total R&D expenditures[3]) measure (Appelt et al., 2019; OECD, 2017).

Because governmental R&D tax incentives generally increase firms' R&D expenditures (Appelt et al., 2019; Brown et al., 2017; Marino et al., 2016), we expect tax reliefs to shift firm resources towards R&D, away from competing activities. Because there is no plausible reason why R&D tax incentives would *directly* affect CSR specialization, we expect a sizable increase of R&D tax incentives to enhance CSR specialization through R&D intensity (than the other way around).

To identify a notable shift of expenditure to R&D, the increase in tax incentives compared to the previous year would have to be substantial. Specifically, we defined a policy shock as a particular country's rise of R&D tax relief above the 75th percentile of all 30 countries' annual change in government's tax relief. We used the 75th percentile because it allows us to separate treatment and control countries into reasonably sized groups, of at least 10 countries each. This would not have been the case if we had chosen the 50th, 90th or the 95th percentile of this variable.

The 75th percentile for all countries and years in our panel equals 0.33%, which corresponds to an increase of 0.33% in tax relief compared to the previous year. Accordingly, countries that increased their R&D tax relief by more than 0.33% are classified as treatment group,

[3] Current R&D expenditure includes: Wages and salaries of researchers and other R&D personnel, payments for R&D services, payment for other services, contributing to R&D carried out by 3rd parties (e.g., collaboration agreements), materials and other consumables and overheads. Capital expenditure includes acquisition of plant and machinery used for R&D, acquisition of software, license and IP rights used for R&D, acquisition of land and buildings used for R&D, and depreciation/amortization of assets used for R&D (Appelt et al., 2019; OECD, 2017).

denoted by "1″; and all other countries fall into the control group (coded "0″). For example, the Australian government implemented a tax relief that, on average, accounted for 15.72% of a firm's R&D expenditure in 2012, which represented an increase of 2.69% compared to 2011, this is substantially larger than the 75th percentile threshold of 0.33% (see Table 5 for details). In contrast, the 6.55% tax relief offered by the South Korean government in 2013 led to an R&D spending increase of only 0.27% over 2012, which is smaller than the 75th percentile threshold. Accordingly, we classified firms based in Australia as treatment group and those in South Korea as our control group.

To avoid contagion by effects related to the global financial crisis of 2008, we focused on the period after 2011 and classified firms based in countries that did not experience a policy shock between 2012 and 2014 into our control group, such that we could consider up to three years before and after the policy shock in our analysis. We coded the variable "Post" as "0″ for the years before the shock and "1″ for the year when the shock occurred and the subsequent three years. Notice that the year of the shock varies by country (see Table 5 for details).

To examine the central assumption of experimental designs—the parallel trends assumption, we implemented a parallel trend test, which examines the null hypothesis that the CSR specialization trends of the treatment and control groups do not differ in the period before the occurrence of a policy shock. Model 1 in Table 6a suggests that the interaction coefficients of the pre-treatment year-dummies with the treatment variables are indeed nonsignificant ("1st year before shock × treatment" $\beta = 0.010$, $p = 0.092$; "2nd year before shock × treatment" $\beta = 0.003$, $p = 0.432$, respectively; the "3rd year before shock × treatment" interaction was omitted due to collinearity). The corresponding F test of the compound null hypothesis that all the coefficients of the group-specific linear trends are jointly zero is also nonsignificant ($p = 0.241$), which suggests the parallel trend assumption holds (Wing et al., 2018). We also plotted the group averages of treatment and control group to facilitate the visual inspection of the pre- and post-shock trends. As displayed in Fig. 1, the group-specific averages in CSR specialization drop in a much more pronounced way in the control group, starting in the year of the shock (year = 0) compared to the treatment group. This preliminary descriptive result suggests that firms in countries that experience an R&D tax relief shock tend to experience a less pronounced decline in CSR specialization compared to firms in countries that do not experience a shock, which is consistent with our expectations.

Table 1
Descriptive statistics.

	Variable	Mean	SD	Min	Max	VIF
1	CSR specialization	0.173	0.095	0.001	0.538	NA
2	RD intensity	0.041	0.064	0.000	0.435	1.74
3	Financial slack	1.939	1.444	0.312	14.036	1.30
4	RD-intensive industries	0.367	0.482	0	1	1.44
5	Consumer-facing industries	0.147	0.354	0	1	1.19
6	Heavily polluting industries	0.147	0.354	0	1	1.17
7	R&D tax incentive (% firms' R&D expenditure)	4.942	4.977	0.000	55.260	1.20
8	Organization size	39,398	83,917	5	2200,000	1.95
9	Return on assets (ROA)	0.050	0.076	−0.464	0.308	1.11
10	Corporate social performance	46.002	8.912	25.513	72.690	1.68
11	Stakeholder pressure	53.191	3.448	25.891	59.270	1.29
12	Industry concentration	0.148	0.193	0.018	1	1.71
13	Market openness	74.136	9.763	40.733	89.267	1.97
14	Quality of regulations	1.281	0.377	−0.749	1.970	1.86
15	GDP (Current US$, unit: billion)	6590	5520	61	16,800	1.80

Note: $N = 13{,}257$. This table reports all the variables in their raw form without transformation. All independent variables and control variables are lagged by one year.

We can therefore confidently implement a DID estimator (Table 6b), specifically, we estimated the following model:

$$CSR\ specialization_{t+1} = \beta_1 Treatment + \beta_2 Post + \beta_3 Treatment \times Post + \gamma X_{it} + \lambda_{it} + \varphi_t + \varepsilon_{it}$$

where i represents firms and t denotes years. X is a vector of control variables; λ and φ are firm and year fixed effects, and ε is the error term. We are interested in the estimate of β_3, the DID estimator, which represents the difference between the two groups in the post-shock period relative to the pre-period, and thus captures the change in CSR specialization in the treatment group relative to the control group.

4. Results

Tables 1 and 2 present the descriptive statistics and correlation matrix, respectively. As expected, R&D intensity is higher in countries with high GDP and in firms with greater financial slack. Similarly consistent with expectations (e.g., Orlitzky, 2001; Udayasankar, 2008),

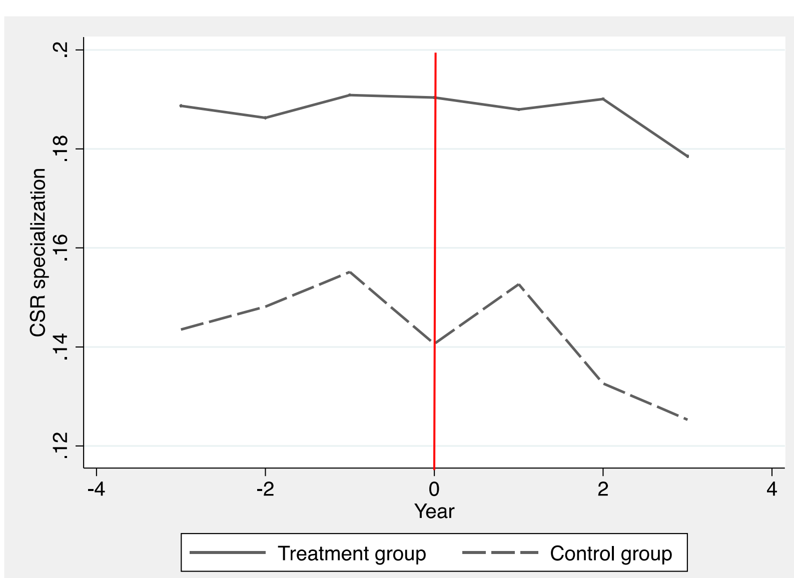


Fig. 1. CSR specialization for treatment and control groups around the R&D tax incentive shock in year = 0.

Table 2
Correlation matrix.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	CSR specialization															
2	RD intensity	0.024	1													
3	Financial slack	0.079	0.297	1												
4	RD-intensive industries	0.051	0.473	0.144	1											
5	Consumer-facing industries	−0.101	−0.198	−0.110	−0.316	1										
6	Polluting industries	0.103	−0.146	0.008	0.099	−0.172	1									
7	R&D tax incentive	−0.018	−0.004	−0.013	−0.016	0.018	0.052	1								
8	R&D tax incentive treatment group	0.191	0.020	0.100	0.004	0.073	−0.006	0.008	1							
9	Organization size	−0.066	−0.083	−0.170	−0.056	0.126	−0.094	−0.029	−0.074	1						
10	Return on assets (ROA)	−0.116	−0.142	0.087	−0.003	0.086	−0.027	−0.025	0.030	−0.018	1					
11	Corporate social performance	−0.072	0.018	−0.200	0.063	−0.035	0.073	0.091	−0.126	0.317	0.018	1				
12	Stakeholder pressure	0.138	0.021	0.118	0.023	−0.063	0.014	−0.018	0.033	−0.410	−0.026	−0.405	1			
13	Industry concentration	−0.220	0.044	−0.080	0.037	−0.032	0.037	0.094	−0.252	0.021	0.004	0.123	−0.047	1		
14	Market openness	−0.163	0.094	0.006	0.025	0.111	−0.048	0.088	0.140	0.000	0.113	0.207	−0.117	0.161	1	
15	Quality of regulations	−0.028	0.074	0.048	0.024	0.006	0.013	−0.022	0.231	−0.047	0.026	0.120	−0.028	0.071	0.591	1
16	GDP	0.109	0.108	0.115	0.061	0.097	−0.155	−0.262	0.327	0.078	0.070	−0.036	−0.085	−0.469	0.080	−0.150

Note: N = 13,257. Correlations larger than 0.02 are significant at $p < 0.05$.

firm size is positively correlated with the aggregate level of corporate social performance. In line with our expectations, CSR specialization is negatively correlated with industry concentration. Multicollinearity is unlikely to be a concern as the variance inflation factors (VIF) of the variables in Table 1 are lower than 1.98.

4.1. Hypothesis tests

Table 3 shows the estimation results for the multilevel models testing the hypothesized association between R&D intensity and CSR specialization and the postulated two-way interactions. Following the best practice recommendations by Snijders and Bosker (2012), we included only the country random effect in the null model. We treated the control variables as fixed effects (including industry fixed effects) in Model 2.

Model 3 and Model 4 test Hypothesis 1 and Hypothesis 2, respectively. Hypothesis 1 proposes that R&D intensity would be positively related to CSR specialization. The coefficient for R&D in Model 3 ($\beta = 0.083$, p = 0.000) suggests that the greater a firm's R&D intensity, the higher its CSR specialization. In other words, firms that have high R&D intensity also seem to be highly focused in their CSR. In short, R&D intensity stochastically predicts CSR specialization, supportive of H1.

Model 4 tests Hypothesis 2, which posits that financial slack would be a negative moderator of the R&D–CSR specialization link. The interaction term in Model 3 ($\beta = 0.001$, p = 0.866) does not lend support to our expectation that the impact of R&D intensity on CSR specialization is contingent on financial slack.

4.2. Robustness checks

We assessed the robustness of our results by using alternative operationalizations for our dependent variable and moderator variable, alternative samples, and alternative model specifications. First, we implemented Harrison and Klein's (2007) and Palan's (2010) recommendations and operationalized CSR specialization as a Herfindahl Index-type measure. The results are consistent with our models reported in Table 3. The regression outputs of alternative operationalizations are reported in Model 1 and Model 2 in Table 4. Second, we excluded industries that have very high levels of R&D intensity: Pharmaceutical & Biotechnology (average R&D intensity of 20.8%) and Technology (average R&D intensity of 10.0%). Model 3 suggests that the results hold for H1 ($\beta = 0.125$, p = 0.000), while H2 (reported in Model 4) is not supported ($\beta = 0.007$, p = 0.535). Model 5 and Model 6 include year × industry effects to control for time variant unobserved heterogeneity at the industry level, and the results of Model 5 suggest that H1 holds ($\beta = 0.083$, p = 0.000), and H2 is not supported (Model 6), as before. Though not reported in Table 4, we also use the Gini coefficient as an alternative measure of CSR specialization, and the results remain largely the same.

Most important, when cash reserves was used as an alternative measure for financial slack, H2 was in fact supported. Cash reserves are more liquid than current assets, which leads to higher managerial discretion in the allocation of slack resources (George, 2005). The results in Model 7 indicate H1 holds ($\beta = 0.102$, p = 0.000), and Model 8 lends now support for H2 ($\beta = -0.02$, p = 0.000). Hence, cash reserves provide more flexibility to expand synergies between R&D and additional ESG dimensions or to mitigate tradeoffs between R&D and CSR. By contrast, the original measure of slack, which includes assets that are more difficult to allocate than cash, may moderate the relationship between R&D and CSR specialization only with considerable time lag.

4.3. Causality test (natural experiment)

Panels A and B of Table 5 present descriptive statistics for the treatment and control groups on the key variables of our study. The t tests before and after the policy shock suggest that CSR specialization and R&D intensity both increased after the shock (see Panel C and D of Table 5). Note that the increase of CSR specialization from the pre-shock to the post-shock period is highly significant in the treatment group ($\delta = 0.014$, p = 0.000), which is considerably larger than the corresponding increase in the control group (δ = 0.005, p = 0.058). As expected, the increase of R&D intensity is nonsignificant in the control group (p = 0.619).

The DID results from random effects and fixed effects models in Table 6b suggest a positive and significant treatment effect of R&D tax relief ($\beta = 0.013$, p = 0.002 and $\beta = 0.013$, p = 0.001) for the random effects (Model 2) and fixed effects models (Model 4) respectively. Based on the combined evidence reported in Tables 5 and 6, R&D tax incentives seem to create a significant treatment effect on CSR specialization, probably through an increase of R&D intensity. Thus, we can conclude with greater confidence that endogeneity (reverse causality) is less likely to be a concern and that R&D intensity indeed causes CSR specialization.

Table 3
The effects of R&D intensity on CSR specialization.

Variables	Model 1 *b/se/p*	Model 2 *b/se/p*	Model 3 *b/se/p*	Model 4 *b/se/p*	Model 5 *b/se/p*	Model 6 *b/se/p*	Model 7 *b/se/p*
Financial slack		0.001***	0.001	0.001	0.001	0.001	0.001
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
		0.001	0.297	0.457	0.214	0.222	0.565
Organization size (ln)		−0.003***	−0.002***	−0.002***	−0.002***	−0.002***	−0.002***
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
		0.000	0.007	0.007	0.002	0.002	0.002
Return on assets (ROA)		−0.073***	−0.099***	−0.099***	−0.101***	−0.104***	−0.102***
		(0.007)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
		0.000	0.000	0.000	0.000	0.000	0.000
Corporate social performance		−0.001***	0.000	0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
		0.000	0.700	0.699	0.897	0.858	0.859
Stakeholder pressure		0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
		0.000	0.000	0.000	0.000	0.000	0.000
Industry concentration		−0.005	0.002	0.002	0.002	0.001	0.002
		(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
		0.352	0.776	0.775	0.8	0.877	0.821
Market openness		0.001***	0.002***	0.002***	0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
		0.000	0.000	0.000	0.000	0.000	0.000
Quality of regulations		−0.003	−0.010	−0.01	−0.01	−0.01	−0.01
		(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
		0.499	0.169	0.169	0.189	0.159	0.16
GDP (ln)		0.005*	0.003	0.003	0.002	0.002	0.002
		(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
		0.078	0.522	0.521	0.59	0.642	0.63
R&D intensity *(H1)*			0.083***	0.080***	0.068***	0.176***	0.239***
			(0.014)	(0.020)	(0.014)	(0.029)	(0.048)
			0.000	0.000	0.000	0.000	0.000
R&D intensity × financial slack *(H2)*				0.001			−0.021
				(0.004)			(0.014)
				0.866			0.129
R&D-intensive industries					0.014***	0.018***	0.018***
					(0.002)	(0.002)	(0.003)
					0.000	0.000	0.000
R&D intensity × R&D-intensive industries						−0.135***	−0.222***
						(0.032)	(0.053)
						0.000	0.000
R&D intensity × financial slack × *R&D-intensive industries*							0.027*
							(0.015)
							0.069
Constant	0.114***	−0.093	−0.145	−0.145	−0.135	−0.129	−0.131
	(0.006)	(0.074)	(0.117)	(0.117)	(0.118)	(0.118)	(0.118)
	0.000	0.210	0.216	0.215	0.251	0.273	0.266
Country-level (*SD*)	0.032***	0.021***	0.031***	0.031***	0.031***	0.031***	0.031***
	(0.004)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm-level *(SD)*	0.087***	0.082***	0.084***	0.084***	0.083***	0.083***	0.083***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Firm-year observations	39,378	22,706	13,257	13,257	13,257	13,257	13,257
Degree of Freedom	24	32	33	34	34	35	38
Wald χ^2	1424.71	1574.99	892.58	892.61	939.34	958.70	965.10
p value of Wald χ^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	−80,040.49	−48,853.02	−28,029.47	−28,027.50	−28,071.23	−28,087.30	−28,087.27
BIC	−79,808.80	−48,571.96	−27,759.75	−27,750.28	−27,794.02	−27,802.60	−27,780.09
Log likelihood	40,047.25	24,461.51	14,050.73	14,050.75	14,072.62	14,081.65	14,084.64

Note: b/se/p represent coefficient, standard error and *p* value, respectively.
Robust standard errors in parentheses; *p* values shown below the standard errors; *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

4.4. Supplemental post hoc analyses regarding industry characteristics

Due to the varying nature of industries (Frankort, 2016; Wu, 2012), the link between R&D intensity and CSR specialization may vary by industry characteristics as well. To explore industry differences regarding the R&D–CSR specialization relationship, we re-classified firms into several subsamples: high and low R&D-intensive industries, consumer- and nonconsumer-facing industries, and heavily polluting and less polluting industries.[4]

Models 6–7 of Table 3 test the contingency of R&D-intensive industries. Model 6 shows a negative moderating effect of R&D-intensive

[4] We thank our anonymous reviewer for the suggestion to explore these industry patterns in greater depth.

Table 4
Robustness test of main results of R&D intensity on CSR specialization.

	HHI as alternative measure		Excluding heavily R&D-intensive industries		Year × industry fixed effect included		Cash reserves as alternative measure for financial slack	
Variables	**Model 1** *b/se/p*	**Model 2** *b/se/p*	**Model 3** *b/se/p*	**Model 4** *b/se/p*	**Model 5** *b/se/p*	**Model 6** *b/se/p*	**Model 7** *b/se/p*	**Model 8** *b/se/p*
Financial slack	0.000	0.000	0.001*	0.001	0.000	0.000	−0.003***	−0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.457	0.560	0.052	0.178	0.392	0.604	0.000	0.000
Organization size (ln)	−0.000**	−0.000**	0.000	0.000	−0.002**	−0.002**	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.011	0.011	0.968	0.973	0.013	0.013	0.888	0.848
Return on assets (ROA)	−0.008***	−0.008***	−0.088***	−0.088***	−0.096***	−0.095***	−0.102***	−0.094***
	(0.001)	(0.001)	(0.012)	(0.012)	(0.010)	(0.010)	(0.010)	(0.010)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Corporate social performance	0.000***	0.000***	0.000**	0.000**	0.000	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.003	0.003	0.011	0.011	0.817	0.816	0.001	0.000
Stakeholder pressure	0.000***	0.000***	0.003***	0.003***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry concentration	0.001	0.001	−0.004	−0.004	0.003	0.003	0.002	0.002
	(0.001)	(0.001)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
	0.229	0.229	0.67	0.671	0.723	0.723	0.749	0.834
Market openness	0.000***	0.000***	0.002***	0.002***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quality of regulation	−0.001	−0.001	−0.013	−0.013	−0.007	−0.007	−0.012	−0.011
	(0.001)	(0.001)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
	0.281	0.281	0.1	0.101	0.361	0.363	0.136	0.157
GDP (ln)	0.000	0.000	−0.001	−0.001	0.001	0.001	−0.001	−0.001
	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
	0.583	0.582	0.833	0.833	0.837	0.835	0.866	0.864
R&D intensity *(H1)*	0.007***	0.007***	0.125***	0.108***	0.083***	0.079***	0.102***	0.356***
	(0.001)	(0.002)	(0.023)	(0.036)	(0.014)	(0.020)	(0.014)	(0.062)
	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
R&D intensity × financial slack *(H2)*		0.000		0.007		0.001		−0.020***
		(0.000)		(0.011)		(0.004)		(0.005)
		0.975		0.535		0.768		0.000
Constant	0.316***	0.316***	−0.096	−0.096	−0.108	−0.108	−0.02	−0.036
	(0.010)	(0.010)	(0.127)	(0.127)	(0.119)	(0.119)	(0.129)	(0.128)
	0.000	0.000	0.449	0.451	0.364	0.364	0.879	0.778
Country-level *(SD)*	0.003***	0.003***	0.033***	0.033***	0.031***	0.031***	0.036***	0.035***
	(0.000)	(0.000)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm-level *(SD)*	0.007***	0.007***	0.082***	0.082***	0.083***	0.083***	0.084***	0.084***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year × industry effects	NO	NO	NO	NO	YES	YES	NO	NO
Firm-year observations	12,685	12,685	10,494	10,494	13,257	13,257	12,244	12,244
Degree of Freedom	33	34	33	34	152	153	33	34
Wald χ^2	798.58	798.58	725.54	725.95	1043.28	1043.37	876.92	896.01
p value of Wald χ^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	−88,526.30	−88,524.30	−22,438.28	−22,436.66	−27,931.95	−27,930.04	−25,819.09	−25,835.01
BIC	−88,258.17	−88,248.77	−22,176.97	−22,168.10	−26,770.65	−26,761.24	−25,552.23	−25,560.73
Log likelihood	44,299.15	44,299.15	11,255.14	11,255.33	14,120.98	14,121.02	12,945.55	12,954.50

Note: b/se/p represent coefficient, standard error and *p* value, respectively.
Robust standard errors in parentheses; *p* values shown below the standard errors; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Model 1 and Model 2 use the Herfindahl index as an alternative measure for CSR specialization. Model 3 and Model 4 exclude some typically heavy R&D-intensive industries: Pharmaceutical & Biotechnology, Technology (including Software, Computer Hardware and Production Technology, etc.); Model 5 and Model 6 include year × industry fixed effect to control for time variant unobserved heterogeneity at the industry level. Model 7 and Model 8 use cash reserves (high-discretion slack) as alternative measure for financial slack.

industry ($\beta = -0.135$, $p = 0.000$), suggesting that R&D-intensive industries are less likely to show high CSR specialization (Fig. 2). This is not surprising because the marginal impact of an increase in R&D intensity on CSR specialization can be expected to be lower for firms that have already a high R&D intensity compared to low R&D intensity firms.

We also investigated whether our (generally rejected) second hypothesis would hold when we distinguish between low and high R&D-intensive industries. We only find a marginally significant 3-way interaction coefficient ($p = 0.069$) and therefore still insufficient support for H2 when current assets to current liabilities is used for slack.

We further compared consumer-facing to nonconsumer-facing industries. The results in Model 2 of Table 7 indicate that the positive link of R&D intensity–CSR specialization is significantly stronger for consumer-facing industries ($\beta = 0.169$, $p = 0.021$). More important, Model 3 shows that Hypothesis 2 is now strongly supported for consumer-

Table 5
Descriptive statistics of control and treatment groups (countries).

Country	*N*	CSR specialization	R&D intensity	Financial slack	Corporate social performance	Average R&D tax incentive	Average yearly change of R&D tax incentive (year 2002–2017)	Year of shock	Change of R&D tax incentive in the year of shock
Panel A: treatment group									
Australia	234	0.161	0.052	2.124	47.631	11.294	1.055	2012	2.690
Austria	64	0.105	0.008	1.461	48.155	6.242	0.128	2012	3.260
Belgium	98	0.131	0.068	1.920	49.205	11.440	1.167	2013	1.549
Brazil	34	0.152	0.006	2.134	53.373	6.236	−1.003	2013	1.660
Canada	210	0.216	0.057	2.647	44.929	18.052	−0.162	2012	1.830
Denmark	134	0.131	0.085	1.742	45.972	0.548	0.100	2012	0.390
Finland	213	0.121	0.026	1.567	50.321	0.042	−0.007	2013	0.350
Greece	10	0.084	0.008	3.168	38.151	1.010	0.142	2012	0.630
Hungary	7	0.093	0.104	3.824	38.925	14.196	−2.624	2014	2.150
Ireland	57	0.160	0.011	1.159	45.101	16.296	1.122	2012	0.340
Italy	65	0.117	0.047	1.186	55.671	3.501	1.024	2012	1.150
Japan	3155	0.219	0.035	2.129	43.823	3.841	0.102	2012	0.480
Netherlands	108	0.144	0.063	1.874	53.724	11.998	0.456	2013	1.400
Norway	60	0.115	0.013	1.717	51.381	7.176	0.328	2013	0.339
Russia	6	0.068	0.001	1.326	45.839	15.017	−0.077	2012	1.400
Spain	78	0.123	0.055	1.656	46.972	4.589	0.078	2012	0.460
Sweden	285	0.130	0.03	1.508	49.667	0.146	0.032	2014	0.520
Turkey	70	0.166	0.005	2.086	43.553	11.044	0.316	2014	1.800
United Kingdom	819	0.123	0.04	1.543	49.532	10.014	1.146	2012	1.000
United States	3880	0.163	0.073	2.236	48.437	3.126	0.094	2012	0.450
Average	*479*	*0.136*	*0.039*	*1.950*	*47.518*	*7.790*	*0.171*	–	*1.192*
Panel B: control group									
China	406	0.147	0.024	1.308	39.818	3.894	0.030	–	–
France	806	0.125	0.046	1.363	53.952	15.941	1.114	–	–
Germany	715	0.113	0.041	1.626	52.365	0.000	0.000	–	–
Luxembourg	16	0.133	0.002	0.808	42.891	0.000	0.000	–	–
Mexico	162	0.105	0.006	3.178	42.772	0.819	−1.417	–	–
New Zealand	41	0.141	0.038	1.554	44.800	0.278	0.129	–	–
Poland	59	0.134	0.002	1.405	49.105	0.145	0.100	–	–
South Africa	451	0.127	0.004	1.607	49.753	1.864	−0.255	–	–
South Korea	408	0.185	0.023	1.434	45.579	5.796	−0.268	–	–
Switzerland	499	0.131	0.061	2.206	48.285	0.000	0.000	–	–
Average	*356*	*0.134*	*0.025*	*1.649*	*46.932*	*2.874*	*−0.057*	–	–

	Pre R&D policy shock (1)	Post R&D policy shock (2)	Diff (2)-(1)	
Panel C: DID analysis of change in CSR specialization				
Treatment group (3)	0.173	0.187	0.014***	p = 0.000
Control group (4)	0.133	0.138	0.005*	p = 0.058
Diff (3)-(4)	0.040***	0.049***	0.009**	p = 0.035
Panel D: DID analysis of change in R&D intensity				
Treatment group (3)	0.042	0.053	0.010***	p = 0.000
Control group (4)	0.038	0.039	0.001	p = 0.619
Diff (3)-(4)	0.005***	0.013***	0.009***	p = 0.007

Note: *** $p<0.01$, ** $p<0.05$, *$p<0.1$.
Although some countries in the control group had higher average yearly change of R&D tax incentive across all years in the sample (year 2002–2017), they did not show a policy shock between the years under study (year 2012–2014).

facing industries ($\beta = -0.176$, $p = 0.000$). That is, the greater the financial slack of firms with high R&D intensity in consumer-facing industries, the lower their CSR specialization, which is consistent with the proposed relationship. Note that, among the six industry subsamples, consumer-facing industries show the lowest R&D intensity of only 1.2% on average (see Table A3 in the Appendix). Empirically, financial slack seems to produce a larger CSR specialization-reducing impact when R&D intensity increases from a smaller basis. Fig. 3 displays the differences between consumer- and non-consumer facing industries.

Regarding the two subsamples of heavily and lightly polluting industries, the effect of the polluting industry dummy on CSR specialization is significant and positive. However, we do not find evidence that belonging to a polluting or nonpolluting industry might change the proposed R&D intensity–CSR specialization relationship in Model 5 of Table 7 ($\beta = 0.082$, $p = 0.388$)—nor the moderating effect of financial slack ($\beta = -0.025$, $p = 0.588$).

5. Discussion and conclusions

This study addressed the managerial challenge of aligning R&D activities with CSR in such a way that firms can attend to stakeholder demands while making efficient use of organizational knowledge, resources, and capabilities. Drawing on the KBV, we found strong evidence for a positive direct effect of R&D intensity on CSR specialization, which is robust across a variety of estimators, measures, and industry analyses. Thus, overall, our study lends support to our theoretical argument that R&D-intensive firms tend to be more focused in their CSR, leveraging synergies and sidestepping resource-related tradeoffs between both organizational processes. Likewise, our results also indicate that firms in consumer-facing industries with abundant financial slack are likely to mitigate the postulated tradeoffs.

Based on these findings, our study makes several contributions. First, we advance theory on the complex relationship between R&D and

Table 6
a) Common trend test. **b**) The treatment effect of country R&D policy on CSR specialization.

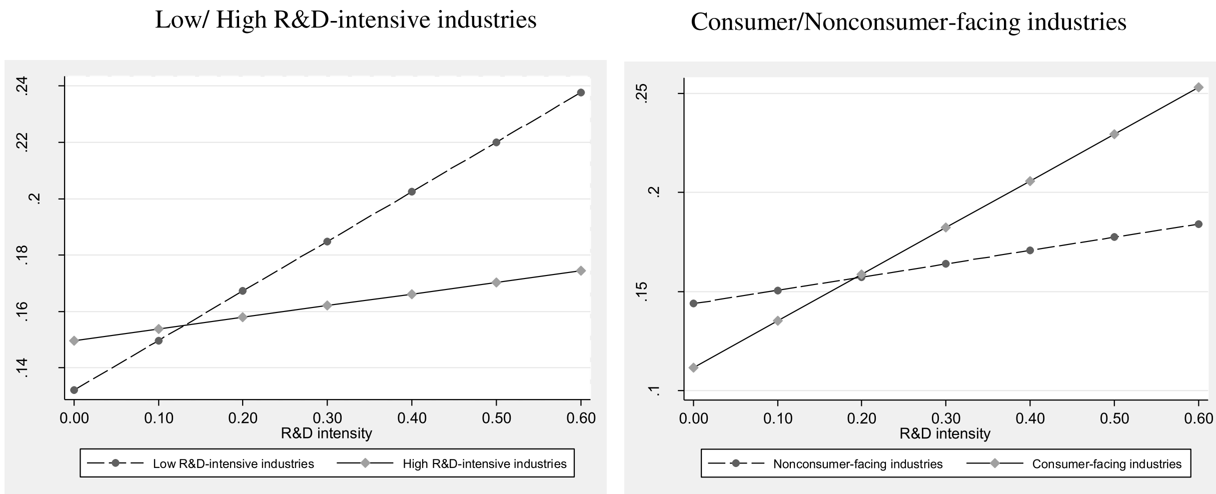
Common trend test			Fixed effects model		Random effects model	
Variable	**Model 1** *b/se/p*	Variable	**Model 1** *b/se/p*	**Model 2** *b/se/p*	**Model 3** *b/se/p*	**Model 4** *b/se/p*
2nd year before shock	0.002					
	(0.004)					
	0.697					
3rd year before shock	0.012**	Treatment				−0.002
	(0.005)					(0.006)
	0.025					0.715
1st year before shock × treatment group	0.010*	Post		−0.017***		−0.018***
	(0.006)			(0.003)		(0.003)
	0.092			0.000		0.000
2nd year before shock × treatment group	0.003	Treatment × Post		0.013***		0.014***
	(0.004)			(0.004)		(0.004)
	0.432			0.001		0.000
Financial slack	0.003*	Financial slack	0.000	0.000	0.001	0.001
	(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
	0.062		0.757	0.746	0.354	0.370
Organization size (ln)	−0.004	Organization size (ln)	−0.002	−0.002	−0.001	−0.002
	(0.003)		(0.004)	(0.004)	(0.002)	(0.002)
	0.206		0.592	0.512	0.443	0.329
Return on assets (ROA)	−0.019	Return on assets (ROA)	−0.028**	−0.030**	−0.035***	−0.039***
	(0.014)		(0.012)	(0.012)	(0.012)	(0.012)
	0.160		0.026	0.015	0.003	0.001
Corporate social performance	−0.001*	Corporate social performance	0.000	0.000	0.000	0.000
	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
	0.065		0.577	0.502	0.981	0.872
Stakeholder pressure	−0.000	Stakeholder pressure	0.001***	0.001***	0.001***	0.001***
	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
	0.670		0.000	0.000	0.000	0.000
Industry concentration	−0.022	Industry concentration	−0.028	−0.033	−0.013	−0.015
	(0.026)		(0.021)	(0.021)	(0.014)	(0.014)
	0.401		0.183	0.118	0.332	0.267
Market openness	0.001**	Market openness	0.003***	0.004***	0.003***	0.003***
	(0.001)		(0.000)	(0.000)	(0.000)	(0.000)
	0.022		0.000	0.000	0.000	0.000
Quality of regulations	0.039	Quality of regulations	0.036**	0.025	0.009*	0.003
	(0.028)		(0.016)	(0.016)	(0.005)	(0.006)
	0.162		0.025	0.121	0.080	0.634
GDP (ln)	−0.021	GDP (ln)	−0.038***	−0.031***	−0.003	−0.002
	(0.018)		(0.008)	(0.008)	(0.002)	(0.002)
	0.243		0.000	0.000	0.276	0.507
Constant	0.747	Constant	0.906***	0.719***	−0.017	−0.049
	(0.518)		(0.233)	(0.232)	(0.071)	(0.070)
	0.149		0.000	0.002	0.810	0.487
Firm fixed effects	YES	Firm fixed effects	YES	YES	YES	YES
Year fixed effects	YES	Year fixed effects	YES	YES	YES	YES
Firm-year observations	3047	Firm-year observations	13,150	13,150	13,085	13,085
Number of firms	1150	Number of firms	1514	1514	1504	1504
R^2	0.020	R^2	0.099	0.102	0.099	0.102
Adjusted R^2	0.015	Adjusted R^2	0.097	0.100	0.097	0.100
F test	3.002	Test statistics (*F* test/Wald χ^2)	23.83	23.46	924.2	1021
p value of *F* test	0.000	*p* value of test statistics	0.000	0.000	0.000	0.000

Note: b/se/p represent coefficient, standard error and *p* value, respectively.

CSR (McWilliams and Siegel, 2001) by proposing a KBV-based model that explains how R&D processes can support CSR specialization in dimensions, such as environmental, social, or governance performance. Specifically, our model implies that tradeoffs exist in the knowledge development of, and resource allocation to, R&D and CSR. These tradeoffs will cause some firms to become more specialized, arguably when resources are stretched, because internal knowledge cannot be developed quickly, and managerial coordination is often difficult. The more differentiated viewpoint of KBV may qualify and modify institutional approaches to CSR (see Doh et al., 2010; Helmig et al., 2016), which focus on environmental forces and typically do not distinguish between different subdimensions of CSR.

Second, our novel construct of CSR specialization can serve as a useful starting point for developing theoretical knowledge about the conditions under which R&D competes for resources with other strategic or organizational interests (Gomez and Vargas, 2009; Schultz et al., 2013). It may allow researchers and practitioners to gage the degree to which R&D may be aligned with specific subdimensions of CSR, such as environmental, social, or corporate governance performance. Though speculative at this stage, CSR specialization may serve as a blueprint for studies about the relationship between R&D intensity and different functional areas, such as marketing or manufacturing as well as between innovation, CSR, and business diversification.

Third, regarding the KBV-inherent paradox mentioned at the outset, we refine the KBV as follows. Although the KBV suggests that coordinating and integrating specialized knowledge can create synergies, the specialized nature of knowledge makes synergies difficult to materialize given the limited applicability of such specialized knowledge



a b

Fig. 2. The effect of R&D intensity on CSR specialization for low/high R&D-intensive industries and consumer/nonconsumer-facing industries.

to different organizational areas and processes. However, we showed that new, multidimensional conceptualizations (i.e., firms as CSR specialists or generalists) can resolve the aforementioned knowledge paradox: synergy-creating and tradeoff-mitigating integration of knowledge across areas requires that the organizational knowledge to be developed and coordinated is highly specialized.

Finally, our findings also reaffirm the importance of organizational environments in this context. Specifically, R&D-intensive firms that are embedded in industries with exceptionally high R&D intensity (in general) may already have exploited synergistic opportunities with a broader range of CSR activities because they also have more R&D resources available to do so. For instance, Huawei's AI-powered technology has generated synergies with a wide range of CSR activities, such as carbon emission reduction (Ingram, 2018) and deaf children's hearing aids (Huawei, 2018), and activities that address the COVID-19 pandemic (Huawei, 2020). In addition, we did find support for the importance of financial slack in consumer-facing industries. This effect is consistent with our theory because consumer-facing industries tend to be more exposed to the general public and, thus, to a broader range of different stakeholder demands (e.g., environmental protection, community welfare, transparency in corporate governance). Thus, firms in consumer-facing industries (with relatively low levels of R&D intensity) may be under greater pressure to use their financial slack to cater to such broader social demands even if their rising R&D intensity, coming up from a low base, requires more resources. This results in reduced CSR specialization. Our supplemental industry analyses may serve as a starting point for the analysis of industry patterns in the context of resource allocation synergies and tradeoffs.

Despite the lack of general support for financial slack as a moderator overall (as postulated in H2), we did find support for the moderating effect of high-discretion financial slack (cash reserves) across all industries. Our contrasting findings reveal how different types of slack may have distinct effects on possible synergy and tradeoffs between R&D and CSR. With high discretion slack, firms can mitigate their current tradeoffs between R&D and CSR faster instead of holding off their investment in R&D or CSR for years. In a similar vein, with easily deployable financial slack resources, firms can afford allocating and training personnel in additional ESG dimensions at greater speed and support them with their R&D capabilities. In terms of the KBV, this implies high-discretion slack allows firms to spur knowledge production and integration more quickly. As such, distinguishing the effects of different types of slack on knowledge production and coordination enrich our above-mentioned contribution to the KBV: the nature of organizational slack resources seems to affect internal tradeoffs in knowledge development and coordination.

In terms of practical implications, our findings suggest that managers ought to seek resource allocation synergies in integrating their organization's expertise in R&D with a strategic focus in CSR (i.e., “narrow but deep”). At the same time, because CSR specialization may emerge inadvertently, managers should monitor if an excessive emphasis on specific CSR dimensions while neglecting other areas could create reputational risk. Overall, to foster and sustain their firm's competitive advantage, executives should align their R&D with their investments in CSR considering internal slack and industry environments more generally.

Although we suggested novel theoretical insights and applied advanced methods (e.g., MLM, DID), no study is without shortcomings and omissions. These could be addressed in future research. First, one of our arguments suggested that higher R&D intensity would be likely to translate into a broader variety of R&D projects in different areas. While this prior research supports this suggestion (Alonso-Borrego and Forcadell, 2010), we could not validate it with our data.

Second, future studies could also include managerial-level predictors to explore how the characteristics of individual business executives, including board member characteristics, may influence the link between R&D and CSR specialization. More risk-averse executives would probably opt for lower CSR specialization to hedge their bets. More broadly, future research should examine how aligning R&D with CSR specialization affects business risk and financial performance. Because of our stipulated resource allocation efficiencies between R&D and CSR specialization, we would expect a generally positive influence on financial performance. However, future research should test under what firm-level and institutional conditions a broad, generalist approach results in higher financial performance than a more focused, specialist approach.

CRediT authorship contribution statement

Limin Fu: Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing - review & editing. **Dirk Boehe:** Conceptualization, Formal analysis, Methodology, Project administration, Resources, Supervision, Writing - review & editing. **Marc Orlitzky:** Conceptualization, Resources, Supervision, Writing - review & editing.

Table 7
Post-hoc analysis: Consumer-facing industries and polluting industries.

	Consumer-facing industries			Heavily polluting industries		
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
	b/se/p	*b/se/p*	*b/se/p*	*b/se/p*	*b/se/p*	*b/se/p*
Financial slack	0.000	0.000	−0.001	0.001	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.451	0.420	0.229	0.27	0.251	0.096
Organization size (ln)	−0.002**	−0.002**	−0.002**	−0.002**	−0.002**	−0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.017	0.017	0.02	0.016	0.017	0.013
Return on assets (ROA)	−0.096***	−0.096***	−0.093***	−0.099***	−0.099***	−0.100***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
	0.000	0.000	0.000	0.000	0.000	0.000
Corporate social performance	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.981	0.932	0.874	0.949	0.96	0.905
Stakeholder pressure	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000	0.000	0.000
Industry concentration	0.002	0.002	0.003	0.002	0.002	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
	0.79	0.805	0.701	0.756	0.758	0.81
Market openness	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000	0.000	0.000
Quality of regulations	−0.011	−0.012*	−0.012	−0.009	−0.009	−0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
	0.111	0.099	0.104	0.206	0.202	0.191
GDP (ln)	0.002	0.002	0.002	0.003	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
	0.625	0.618	0.616	0.479	0.495	0.503
R&D intensity	0.073***	0.067***	0.039	0.084***	0.083***	0.084***
	(0.014)	(0.014)	(0.021)	(0.014)	(0.014)	(0.021)
	0.000	0.000	0.059	0.000	0.000	0.000
R&D intensity × financial slack			0.009**			−0.002
			(0.005)			(0.005)
			0.04			0.729
Consumer-facing industry dummy	−0.030***	−0.032***	−0.048***			
	(0.003)	(0.003)	(0.004)			
	0.000	0.000	0.000			
R&D intensity × consumer-facing industries		0.169**	0.525***			
		(0.073)	(0.117)			
		0.021	0.000			
Financial slack × consumer-facing industries			0.009***			
			(0.002)			
			0.000			
R&D intensity × financial slack × consumer-facing industries			−0.176***			
			(0.043)			
			0.000			
Heavily polluting industries				0.026***	0.025***	0.030***
				(0.005)	(0.005)	(0.006)
				0.000	0.000	0.000
R&D intensity × heavily polluting industries					0.082	0.139
					(0.095)	(0.133)
					0.388	0.295
Financial slack × heavily polluting industries						−0.003*
						(0.002)
						0.075
R&D intensity × financial slack × heavily polluting industries						−0.025
						(0.046)
						0.588
Constant	−0.125	−0.127	−0.126	−0.178	−0.174	−0.172
	(0.116)	(0.116)	(0.117)	(0.117)	(0.117)	(0.117)
	0.281	0.273	0.279	0.129	0.137	0.143
Country-level (*SD*)	0.030***	0.030***	0.031***	0.031***	0.031***	0.031***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000	0.000	0.000
Firm-level (*SD*)	0.083***	0.083***	0.083***	0.083***	0.083***	0.083***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES
Firm-year observations	13,257	13,257	13,257	13,257	13,257	13,257
Degree of Freedom	34	35	38	34	35	38
Wald χ^2	1027.03	1032.80	1061.94	921.08	921.87	927.36

(*continued on next page*)

Table 7 (*continued*)

	Consumer-facing industries			Heavily polluting industries		
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
p value of Wald χ^2	0.00	0.00	0.00	0.00	0.00	0.00
AIC	−28,152.83	−28,156.17	−28,177.21	−28,054.14	−28,052.88	−28,052.02
BIC	−27,875.61	−27,871.46	−27,870.03	−27,776.92	−27,768.10	−27,744.84
Log likelihood	14,113.41	14,116.08	14,129.61	14,064.07	14,064.44	14,067.01

Note: b/se/p represent coefficient, standard error and *p* value, respectively.
Robust standard errors in parentheses; *p* values shown below the standard errors; *** $p<0.01$, ** $p<0.05$, *$p<0.1$.

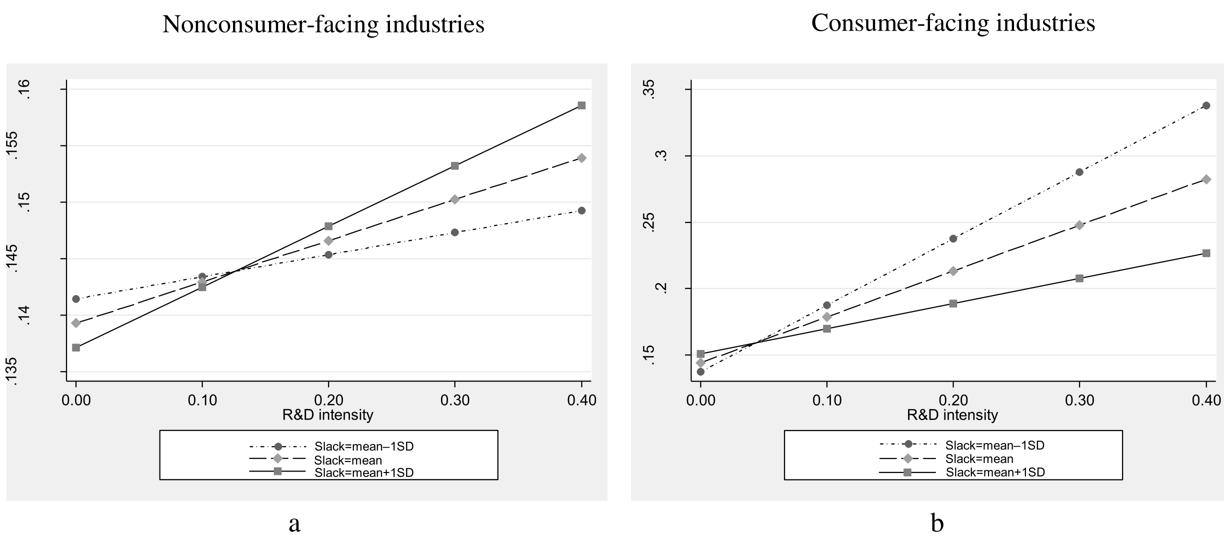


Fig. 3. The effect of R&D intensity on CSR specialization at varying levels of financial slack for nonconsumer-facing industries and consumer-facing industries.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.respol.2020.104082.

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