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Do social policies foster innovation? Evidence from India's CSR regulation

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ABSTRACT

We examine the effect of social policies on corporate innovation using India's mandatory Corporate Social Responsibility (CSR) regulation. This regulation mandates firms with pre-tax profits above a certain threshold to spend 2 % of the profits on CSR. We demonstrate a significant bunching of companies just below the profit threshold post-regulation compared to the pre-regulation period. Firms close to the profit threshold manipulate their earnings to avoid compliance by increasing their R&D expenses. We show that, on average, firms that increase R&D expenses to avoid the regulation apply for one more patent and announce two new products. The increase in R&D expenses and patenting is concentrated in firms with a prior history of innovation. Our results suggest that social policies can generate indirect incentives for innovation.

1. Introduction

Innovation is a key driver of firm value and overall economic growth (Solow, 1957; Kogan et al., 2017). However, firms are often reluctant to invest in innovative projects with long gestation periods and high probabilities of failure. Therefore, governments encourage corporate innovation through a range of public-policy incentives. For example, fiscal policy measures such as corporate tax cuts and research and development (R&D) tax credits incentivize corporate innovation (Atanassov and Liu, 2020; Mukherjee et al., 2017; Mansfield, 1986; Wilson, 2009; Bloom et al., 2019). Similarly, education and labour market policies and trade and competition policies also foster innovation in the long run (Bianchi and Giorcelli, 2018; Hunt and Gauthier-Loiselle, 2010; Moser et al., 2014; Blundell et al., 1999; Bloom et al., 2016; Aghion et al., 2018).

This paper examines the impact of a different class of public policies on corporate innovation. Lawmakers are increasingly focusing on regulations regarding sustainable and socially responsible business practices. These include non-financial reporting obligations, pressures to switch to environmentally friendly production technologies, and recognition of the interests of a broader set of stakeholders. These social and sustainability policies are disruptive to the firm's traditional business practices and are costly to implement (McWilliams and Siegel, 2001; Chhaochharia et al., 2021). Since a large majority of corporate innovations are funded from retained profits, public policies that increase corporate expenses and decrease profits are likely to dampen innovation activities, such as R&D expenses and patent development (Hall and Lerner, 2010).

We focus on India's corporate social responsibility (CSR) regulation of 2013. This regulation, commonly known as Section 135, made it mandatory for Indian firms, above a certain threshold of size and profitability, to spend 2 % of their pre-tax profits on CSR projects.[1] Firms that meet the threshold criteria incur significant administrative costs, over and above the 2 % target, for setting up CSR projects (Chhaochharia et al., 2021; Homroy et al., 2020; Guha, 2020). The law also mandates that the CSR projects must target impact areas unrelated to the firms' operations.[2]

The mandatory CSR expenses will reduce net profits; therefore, firms

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[1] The thresholds are as follows: net worth of ₹5 billion (approximately US$ 69 million), turnover of ₹10 billion (approximately US$ 149 million), or net profit of ₹50 million (approximately US$ 695,000).

[2] The administrative cost of paying additional corporate tax doesn't vary by the amount of tax paid. However, for Section 135, the compliance costs include the cost of selecting and implementing CSR projects, either directly by the firms or through implementation agencies, identification of implementation agencies, the coordination costs of phased rollout that many projects require, etc. (Homroy et al., 2020).

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will likely attempt to avoid them. Firms close to the qualifying thresholds of Section 135 face the strongest incentives to avoid it. A firm close to (but just above) the pre-tax profit threshold can avoid qualifying by manipulating profits to bring the reported earnings beneath the threshold. Drawing on real earnings management literature, these firms will likely increase expenses to the extent that reported profits fall below the threshold (Roychowdhury, 2006). We hypothesize that firms with profits close to but above the threshold will increase R&D expenditure and report earnings beneath the threshold. Later in the paper, we discuss why we expect firms to increase R&D expenses but no other corporate expenses.

Two strands of the theoretical literature on corporate innovation inform the effect of the CSR regulation on corporate innovation. First, since innovation inputs (R&D expenses) are likely to be funded from retained earnings, and the mandatory CSR law reduces retained earnings (exactly as does an increase in corporate tax), Section 135 could result in reduced R&D expenses (Mukherjee et al., 2017; Tirole, 2010).[3] On the other hand, such a legal mandate reduces the strategic advantage of discretionary CSR (Dharmapala and Khanna, 2018). In this case, for a firm at the qualification threshold, returns to an additional dollar spent on innovation can have higher expected returns in future profits than that spent on CSR expenses (Bénabou and Tirole, 2010; Kitzmueller and Shimshack, 2012). Therefore, firms can increase R&D expenses if doing so reduces the pre-tax profits to below Section 135's minimum threshold.

We empirically test our hypothesis using data from Prowess. We focus on all firms listed on the two main stock exchanges (the Bombay Stock Exchange and the National Stock Exchange). First, we show that the CSR expenses of Indian firms increased following the CSR regulation. However, we find no difference in CSR expenditure of innovative firms compared to non-innovative firms.

Next, we focus on firms close to the qualification thresholds. Firms close to any of the three thresholds will have incentives to manipulate the parameter and avoid the regulation. Most commonly, firms qualify for the CSR law because they cross the pre-tax profit threshold. In our sample, 3293 firms enter the treatment group by crossing *only* the profit threshold, whereas 1186 and 355 firms qualify by *only* crossing the turnover and net worth criteria, respectively. However, not all three criteria are equally easy to manipulate. For example, the literature on real earnings management shows that profits can be manipulated by increasing expenses relatively easily but manipulating net worth and sales turnover has more significant impacts on corporate strategy in the long run (Roychowdhury, 2006). Therefore, earnings management to avoid the CSR regulation is more likely for firms closer to the profit threshold than firms closer to the net worth and the sales revenue thresholds.

We focus on the subset of firms beneath Section 135's pre-tax profit threshold and compare them with firms further below the threshold.[4] If firms just above the profit threshold engage in earnings management (i.e., under-report their pre-tax profits to avoid qualifying for the CSR law), we expect to see bunching at the pre-tax profit threshold. There will be a high density of firms just below the profit threshold and a lower density of firms just above the threshold. We find this bunching pattern in the post-regulation period but not pre-regulation.[5] Further, we show no bunching at Section 135's turnover and net worth thresholds before or after the regulation. These observations are consistent with firms engaging in earnings management to avoid qualifying for the CSR law.

Next, we examine if firms reduce their profits by increasing their R&D expenses to avoid Section 135. For this analysis, we take the set of all firms that report an annual pre-tax profit of less than ₹50 million. We create an indicator, *Bandwidth*, for firms with a pre-tax profit between ₹40 million and ₹49 million. This indicator allows us to compare the difference in R&D expenditure for firms close to (but beneath) the profit threshold compared to firms further below the threshold. Since we study the endogenous sorting of firms in the *Bandwidth*, we can't estimate a traditional difference-in-differences model. Therefore, we estimate the difference between the firms in the *Bandwidth* and the control group by using the interaction of *Bandwidth* and an indicator for the post-regulation years (2014–2019). With firm and year fixed effects, it shows the change in innovation inputs for firms just beneath the profit threshold compared to firms further below.

We show that the firms in the bandwidth just beneath the threshold increased R&D expenses in the post-regulation period relative to firms further below the threshold. The increase in R&D expenses of these firms is economically meaningful: firms in the bandwidth increased their R&D expenses by 3.1 % post-CSR regulation compared to firms further below the threshold. Since the mean R&D expense of the firms in our sample is ₹360 million, this increase adds an extra ₹11.16 million in innovation inputs across all firms.[6] Additionally, we find no statistically significant change in other expenses such as staff, energy, and administrative costs for firms in the *Bandwidth*. Since expenses such as wages, salaries, and overhead costs fluctuate with economic conditions and are often hard to subsequently adjust downwards, firms are unlikely to increase these expenses to evade the CSR regulation. On the other hand, R&D is a forward-looking expense, and increasing these expenses can generate a future competitive advantage for some firms.[7]

An important concern is that firms allocated optimal resources to CSR and R&D pre-regulation. Changing either of these expenses in response to the regulation will likely render the resource allocation inefficient. Therefore, it is important to investigate why firms increase R&D expenses to avoid increasing CSR expenses. It is a salient issue because setting up an R&D infrastructure is a costly long-term project, and most managers are known to have myopic planning horizons. We argue that since increasing either R&D or CSR expenses will be inefficient resource allocation options, firms will choose the *less inefficient* option between the two.

Towards that end, we examine whether our results can be explained by the set-up costs of CSR projects and R&D infrastructure. Firms with a history of innovation in the pre-regulation period have already incurred the fixed costs of setting up an R&D infrastructure. The expected value of additional R&D expenses on future profitability is positive. Therefore, these firms will likely increase their R&D expenses to avoid qualifying for the CSR regulation (Curtis et al., 2020; Bloom et al., 2016). On the other hand, firms with no history of innovation must set up an R&D infrastructure, making it costly for them to adopt this strategy. If innovation were salient to these firms' operations, they would have incurred R&D expenses pre-regulation. For these firms, complying with the CSR regulation is less inefficient than setting up an R&D infrastructure.[8]

Therefore, we investigate whether firms uninvested in innovation

[3] Both corporate innovation and CSR expenses are largely funded from retained profits because either asymmetric information or a principal–agent conflict implies that new debt or equity finance will be relatively more expensive for R&D than for ordinary investment. Additionally, lack of collaterals makes it harder to debt finance these investments (Hall and Lerner, 2010; Tirole, 2010).

[4] We don't compare with firms above the threshold because these firms endogenously choose to comply with the regulations.

[5] In the pre-regulation period, there is evidence of bunching at zero profits.

[6] To ensure that our results are not contaminated by industry and time-specific factors such as R&D tax credits, we show that our results remain qualitatively similar when estimating the regressions with industry-year fixed effects (Ivus et al., 2021).

[7] We also show heterogeneity in the effect of the CSR regulation on the R&D expenses of firms in the *Bandwidth*. Large firms (in the highest quartile of the size distribution), manufacturing firms, and firms in innovative industries (industries with high levels of patent applications) increased R&D expenditure relative to smaller firms, in less innovative industries, and service sector firms.

[8] Less innovative firms can donate the required CSR amount to a foundation at lower compliance cost compared to setting up R&D infrastructure.

before the CSR regulation started spending on R&D or previously innovative firms increased their innovation activities after the CSR regulation. We show that the post-regulation R&D expenses of innovative firms (firms that invested in R&D and filed patents pre-regulation) increase relative to less innovative firms. Firms with no patent filings and R&D expenses in the pre-regulation period do not increase their R&D expenses. Therefore, our results highlight that the CSR regulation did not affect the extensive margin (new firms do not start investing in innovation) of corporate innovation, but it affected the intensive margin (innovation inputs of already innovative firms increased).

Finally, the socially relevant question is whether the increased R&D expenses of firms affect innovation outcomes. If the post-regulation increase in R&D expenses is not invested productively, we should see no effect on innovation outcomes. We investigate the real effects of the increased R&D expenses by focusing on innovation outcomes like patent applications and new product announcements (Chen et al., 2021). First, we show that firms in the *Bandwidth* filed more patent applications and announced more new products following the CSR regulation compared to firms further below the profit threshold. Second, we show stronger effects on innovation outcomes for firms in the *Bandwidth* that increased R&D expenditure post-regulation. These firms filed 1.3 more patent applications and announced two more new products than firms that did not increase their R&D expenses.

This paper contributes to several strands of the literature. To the best of our knowledge, we are the first to show the effect of social policies on corporate innovation. In doing so, we contribute to a large literature that examines the impact of public policy on innovation (Bloom et al., 2019). Existing papers show the effect of traditional policy measures like fiscal incentives (Mukherjee et al., 2017; Atanassov and Liu, 2020), increasing the supply of highly skilled labour (Bianchi and Giorcelli, 2018; Hunt and Gauthier-Loiselle, 2010; Moser et al., 2014), and positive spillovers from trade openness (Blundell et al., 1999; Bloom et al., 2016). Our novel contribution is that we provide an additional public policy pathway to incentivize corporate innovation.

Related to this point, our results inform the debate on fiscal incentives for innovation. Direct fiscal incentives for corporate innovation can generate suboptimal responses if firms relabel other operational expenses to receive R&D tax credits (Chen et al., 2021). In such a case, innovation activities do not increase, and governments collect less tax revenues. Section 135 does not provide direct fiscal incentives for innovation; hence, relabelling concerns are likely to be low. In this case, innovative firms are incentivised to increase their R&D expenses. In contrast, non-innovative firms have a stronger incentive to comply with the CSR regulation because of the fixed costs of setting up R&D activities.

Additionally, our results highlight that if the threshold for public policy qualifications is based on characteristics that are endogenous to the firm or easily manipulable, it will have unintended consequences. The CSR regulation introduces a constraint on the minimum amount that firms must allocate to CSR. Assuming that Indian firms were allocating an optimal amount of resources to CSR and R&D pre-regulation, changing either of these expenses will make the resource allocation inefficient. In that case, firms will choose the *less inefficient* option between these two. In our setting, increasing R&D expenses is still an inefficient resource allocation because, absent the legal mandate for CSR expenditure, these firms were not spending the additional amount on R&D that they do post-regulation. However, it is less inefficient for innovative firms to scale up R&D expenses than incurring CSR expenses. Even though firms choose between inefficient options, an increase in patent applications and new product announcements indicates that these inefficiencies generate tangible innovation outcomes.

Next, our paper contributes to the growing literature on Indian firms' innovation and CSR activities. Closely related to our study, Jain and Krishnapriya (2020) show that the innovation activities of Indian manufacturing firms positively affect their CSR spending. While they show that Indian manufacturing firms' average CSR spending positively correlates with their innovation activities without a legal mandate, we demonstrate the CSR regulation's incentivising effects on innovation when firms strategically choose to evade the CSR regulation.

Further, our paper is also related to the literature focused on the factors that stimulate R&D expenses in emerging markets. For example, R&D tax credits, foreign direct investments, changes in patent policies and corporate governance regulations can all foster corporate innovation (Ivus et al., 2021; Sasidharan and Kathuria, 2011; Ambrammal and Sharma, 2014; Helmers et al., 2017). We contribute to this literature by highlighting that social and sustainable policies also increase the innovation activities of emerging market firms.

Finally, we contribute to the literature on how Indian CSR regulation affects the outcomes of Indian companies. The regulation has been detrimental to shareholders' wealth for affected firms, at least in the short term (Dharmapala and Khanna, 2018; Manchiraju and Rajgopal, 2017).[9] The critical insight from our study is that an evaluation of the overall impact of Section 135 on shareholders' wealth must include the affected firms and those that manipulate earnings and avoid the regulation. Long-term shareholders' wealth can increase for the latter group due to increased R&D expenditure and innovation outputs.

The rest of the paper proceeds as follows. Section 2 discusses the institutional setting and the conceptual framework; Section 3 discusses the data and the methodological choices; Section 4 presents the results of the empirical tests, and Section 5 concludes.

2. Institutional background and conceptual framework

2.1. Section 135 of the Indian Companies Act and CSR Committees

India was the first country to mandate CSR spending in 2013 vides Section 135 of the modified Companies Act. The regulation came into effect in April 2014 on a “comply-or-explain” basis. The regulation applies to all firms operating in India - public or private, domestic or foreign-owned. A firm is affected by the regulation if it meets or exceeds any of the three threshold criteria in the immediately preceding fiscal year. The criteria are as follows: net worth of ₹5 billion (approximately US$ 69 million), turnover of ₹10 billion (approximately US$ 149 million), or net profit of ₹50 million (approximately US$ 695,000). The affected firms will have to spend a minimum of 2 % of their average pre-tax profits on CSR. Section 135 highlights specific impact areas (or Schedules) through which the mandated amount should be spent (Dharmapala and Khanna, 2018).

The regulation also explicitly sets out the expenses that are not considered for compliance purposes. For example, expenses related directly to a firm's operations (e.g., fostering employee engagements) cannot be counted as CSR; neither can the cost of implementing CSR projects. Similarly, expenses on CSR activities outside India cannot count towards legal compliance, and firms are encouraged to engage in CSR activities around their headquarters in India.

Firms must invest in projects that meet the following impact areas that qualify as CSR activities: (i) eradicate hunger, poverty, and malnutrition; (ii) promote education, special education, and employment enhancing vocation skills; (iii) promote gender equality and empowering women; (iv) ensuring environmental sustainability and ecological balance; (v) protection of national heritage, art, and culture; (vi) measures for the benefit of armed forces veterans, war widows, and their dependents; (vii) training to promote rural sports, nationally recognized sports, Paralympic sports, and Olympic sports; (viii)

[9] Our bunching results contrast with Dharmapala and Khanna (2018) and Manchiraju and Rajgopal (2017), who find no effect of manipulation at the thresholds to avoid treatment. To reconcile these results with ours, we highlight that these papers focus on the short-run effects immediately following the law, whereas we focus on a longer time series that allows the companies to adopt a strategic position.

contribution to the Prime Minister's National Relief Fund or any other fund set up by the central government; (ix) rural development projects; (x) slum area development (The Companies Act, 2013).

Regarding Section 135, it is important to discuss the rationale for (a) making CSR mandatory and (b) implementing it on a comply or explain basis. It is an important issue because the regulation might be endogenous to firm actions. At the heart of the issue are two (related) concerns:

1. Are there unobservable factors that drive both the CSR law and the R&D expenditure of firms in the *Bandwidth*, i.e., firms just below the pre-tax profit threshold (omitted variable bias)?
2. Have the *Bandwidth* firms' past actions (specifically their CSR and R&D expenses) led to the CSR regulation being instituted (reverse causality)?

If the potential impact of the CSR regulation on R&D is due to factors not considered in our conceptual and empirical models, they will confound our results. For example, change in innovation incentives can explain increased R&D expenses. Similarly, export market conditions and changes in equity ownership patterns can drive corporate innovation. An increase in the exposure of Indian firms to export markets and foreign institutional investors can increase CSR expenses and innovation activities (Luong et al., 2017; Dyck et al., 2019; Banerjee et al., 2020). Although there are no direct econometric tests to rule out all possible confounding channels, it is important to provide evidence that the most obvious confounding factors do not drive our findings on innovation expenses. In our empirical analysis, we provide such evidence.

Second, regulations are likely driven by socio-economic factors, including the past behaviour of firms. For our analysis, it is important to establish that Indian firms' prior innovation activities did not motivate the formation of the CSR regulation. The Government of India has not officially justified the economic rationale for the CSR regulation, but the Minister of Corporate Affairs stated that full compliance with the regulation can generate additional revenues for social development projects (Business Today, 2013). Economically, India performs poorly on various social development metrics and inequality measures (Drèze and Sen, 2013; Chancel and Piketty, 2019). Thus, the government may have wanted to generate additional revenue from the corporate sector to fund developmental projects. Yet while generating additional revenue could be a valid argument for creating the regulation, it is an insufficient explanation for why profit-maximizing firms should undertake developmental projects directly.

Another way to raise revenue would be to increase corporate tax. However, corporate tax rates in India were already high, and, combined with the inefficiency of tax collection, these reasons could be why the government did not raise corporate tax directly (Rayp and Van De Sijpe, 2007; Jahnsen and Pomerleau, 2017). Yet critics saw the CSR regulation as an indirect form of taxation, stating that "a mandatory expenditure is a tax… This is a back-door way to increase corporate taxes without a transparent political debate" (Karnani, 2013). The insertion of the mandated CSR clause may also have been a balancing factor for the otherwise pro-business Companies Act 2013 (Guha, 2020). These reasons indicate that the CSR regulation was most likely a public finance decision and not a response to concerns about profitability, CSR expenditure or R&D expenditure of Indian firms.

Additionally, there is no official explanation for the "comply or explain" policy. Given that the regulation has no global precedence and specifies a set of channels through which the CSR expenses had to be incurred, it is plausible that the government allowed an adjustment period for firms to set up a spending infrastructure. Over time, the government introduced penalties for non-compliance. For example, in January 2021, the Indian government introduced monetary penalties for non-compliant firms.

2.2. Conceptual framework

Before the CSR regulation, Indian firms optimised, among other things, CSR and R&D expenditures. Firms spend on CSR activities to attract customers, investors, and employees (Turban and Greening, 1997; Baron, 2001; Maxwell et al., 2000). R&D investments are motivated by greater (expected) future competitiveness through innovation. Since these are endogenous decisions, the expected returns from CSR and R&D must be positive for firms to invest in them. For firms making these investments, the return must be equal to or greater than the unit cost. Before Section 135, Indian firms made CSR and R&D choices based on such considerations.

Section 135 introduces additional costs that force firms to deviate from their pre-regulation optimum. Incurring CSR expenses can benefit some firms in the long run, but uncertainties related to the measurement and the time lag of these benefits makes such expenses risky (Albuquerque et al., 2019). Therefore, firms that did not do CSR pre-regulation and are close to the qualifying thresholds of Section 135 will try to avoid compliance (Manchiraju and Rajgopal, 2017).

In principle, firms close to any of the three thresholds will try to manipulate them. In the case of Section 135, not all three criteria are equally likely to be manipulated. Net worth and sales turnover are harder to manipulate in the short term relative to pre-tax profits. To avoid qualification by reducing net worth (investments in the firm made by the shareholders in equity capital and the firm's profits generated and retained as reserves), firms would have to sell their tangible assets at undervalued prices or distribute retained earnings. Actions, like asset selloffs, can affect productive capacity and would, hence, be a disproportionate response to avoid Section 135 compliance. Similarly, reducing sales revenues to prevent qualification has implications for long-term profits. Manipulating sales to influence earnings is a viable strategy if the firm aims to meet a target on a specific day - for example, the financial year-end (Roychowdhury, 2006). However, the CSR regulation cut-off is on a rolling basis of three-year moving averages. In this case, deferring sales revenue to the next accounting cycle is unlikely to be a successful strategy to avoid qualification. Pre-tax profits, on the other hand, can be relatively easy to manipulate by increasing corporate expenses. Therefore, we hypothesize that earnings management to avoid the CSR regulation is a viable strategy only for firms closer to the pre-tax profit thresholds (and not crossing the other two thresholds).

Hypothesis 1. Firms closer to only the CSR regulation's profit threshold will reduce their pre-tax profits to avoid compliance.

Firms can either reduce short-term income (deferred income etc.) or increase operating costs to report lower pre-tax profits. As noted above, since the CSR mandate is not based on a specific date but over a moving average of three years, deferring earnings to avoid qualification is unlikely to be an effective strategy. Therefore, we focus on the cost increase channel. Firms that increase costs to avoid compliance will likely focus on expenses that can readily increase and potentially generate long-term benefits (Bereskin et al., 2018). Most corporate expenditures (such as compensation, overhead, and professional service costs) fluctuate with local and global economic conditions. Additionally, some of these costs, such as wages and salaries, are difficult to adjust downward with changing economic conditions. Therefore, an ad-hoc increase in these expenditures (that are unrelated to actual business requirements) will likely burden firms with a sub-optimally high-cost structure.

On the other hand, R&D expense can be a source of competitive advantage, and the increased innovation inputs will likely yield long-term benefits. Consequently, we hypothesize that firms will increase R&D expenses to avoid compliance with the CSR regulation. This approach allows firms to allocate resources to productive technology while avoiding CSR expenses with unclear long-term benefits.

Hypothesis 2. To avoid compliance, firms closer to the CSR regulation's profit threshold will increase R&D expenses.

The choice to incur R&D costs instead of the mandatory CSR expenses is likely to depend on the relative benefits of CSR and R&D to the firm (Tirole, 2010). A firm decides on the level of CSR expenditure based on the return from an additional dollar of such spending. If the present value of the long-term returns from an extra dollar of CSR expenditure is less than a dollar, the firm will stop spending on CSR. If the policy forces it to do so, the dominant strategy will be to explore ways to avoid making this inefficient expenditure. Hypothesis 2 posits that firms will increase R&D expenses to avoid compliance. It is an unintended consequence of the CSR policy that makes resource allocation inefficient. Like CSR expenses, a firm decides on its R&D expenses based on the present value of its long-term returns. If the return were more than the cost, firms would already have invested in R&D, even without the CSR regulation. Following the CSR regulation, firms will increase R&D not because the policy makes it more productive but because it is less inefficient than spending on CSR.

In other words, firms will avoid CSR expenditure by increasing R&D (and fall below the profit threshold) only when it is the lesser of the two inefficient paths. Innovative firms with a well-developed R&D infrastructure are more likely to follow this strategy than those yet to set up R&D activities, as implementing an innovation infrastructure is costly in terms of acquiring physical assets and human capital (Siddharthan, 1992; Del Canto and Gonzalez, 1999; Özçelik and Taymaz, 2008). We hypothesize that firms closer to the profit threshold with a prior history of innovation will increase R&D expenses to avoid the CSR regulation (Mukherjee et al., 2017; Atanassov and Liu, 2020). These firms have already incurred the fixed costs of setting up an R&D infrastructure, and increasing R&D expenses is likely the lesser of the two inefficient paths.

Hypothesis 2a. Firms with a history of innovation will increase R&D expenses to avoid compliance with the CSR regulation.

As stated before, the underlying rationale for firms to increase R&D expenses and avoid CSR regulation is that firms perceive higher long-term benefits of R&D over CSR expenses. If firms allocate more resources towards innovation productively, we expect it to positively affect future innovation outcomes (Atanassov and Liu, 2020; Bloom et al., 2019). Therefore, increased R&D expenses should lead to better innovation outcomes measured by future patent applications and new product launches (Mukherjee et al., 2017).

We hypothesize that firms increasing R&D expenses to avoid complying with the CSR regulation will apply for more patents and develop more new products than firms that do not increase R&D expenses to avoid compliance.

Hypothesis 3. Firms that increase R&D expenses to avoid complying with the CSR regulation will have more future patent applications than firms that do not increase R&D expenses.

Hypothesis 3a. Firms that increase R&D expenses to avoid complying with the CSR regulation will have more new product announcements than firms that do not increase R&D expenses.

3. Data and empirical strategy

3.1. Sample selection and summary statistics

We use the information on all listed Indian firms from Prowess, which provides data on financial indicators of Indian firms. We start with all 8431 firms listed on the two main Indian stock exchanges – the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) for 2010–2019.[10] It is a commonly used sample selection criteria to examine R&D expenses in the Indian context (Helmers et al., 2017). This sample contains 76,380 firm-year observations. For our empirical models, we require that information on financial, corporate governance, and ownership variables are available for a firm in all years of our sample period. This criterion restricts the sample to 41,412 firm-year observations. The sample firms' mean pre-tax profits, net worth, and sales turnover are ₹6546 million, ₹13,918 million, and ₹23,674 million, respectively. The mean (median) R&D expenses of firms in our sample are ₹360 million (₹23 million), and approximately 21 % of firms have zero R&D expenses.[11]

Within this sample, we identify firms that qualify for compliance with the CSR regulation based on pre-tax profit, turnover, and net worth thresholds. 5348, or 63 %, of all firms, qualify on at least one of the three criteria, and 1261 firms qualify on all three. The CSR law commonly applies to Indian firms because they are over the profit threshold. The CSR regulation applies to 3293 firms for crossing only the profit threshold, whereas 1186 and 355 firms qualify by only crossing the turnover and net worth criteria. Our main estimation sample is the subset of firms that can enter treatment by crossing *only* the profit threshold. The estimation sample comprises 2016 firms (19,639 firm-year observations) with pre-tax profits lower than ₹50 million.

Our empirical design focuses on firms with a narrow bandwidth around the pre-tax profit threshold (₹40 million to ₹49.99 million). In this bandwidth, we have 1890 observations with an average R&D of ₹37 million.[12] Table 1 presents the summary statistics, and appendix 1 describes the main variables. Based on this data, we construct an *Innovative Firm* dummy, which equals '1' if a firm has applied for at least two patents in the 2010–2013 period. These are the firms for which R&D is easier to scale up. We also create a dummy, *Innovative Industry*, which equals '1' if the collective number of patent applications of all firms in that industry between 2010 and 2013 is in the top quartile of the industry-wide patent application distribution.

We collect data on patents filed by Indian firms from the Controller General of Patents, Designs & Internal Trademarks database (CGPDT). We retrieve the data from their web-portal inPASS, which contains all patent data in India filed from 2005 onwards. We extract all patent applications from January 2010 to December 2019, where the applicant's country of registration is filed as "India". It leads to a sample of approximately 89,000 patents.[13] We use a fuzzy matching algorithm to associate the firm names in the patent application to that of the Prowess sample and manually check the quality of matches above a match ratio of 0.95. This results in a final sample of 26,631 patent applications of sample firms between 2010 and 2019. Using the patent data described above, we create a variable, *#Patent Applications*, which measures patents filed by a firm. The mean (median) patent applications of Indian

[10] Prowess covers over 50,000 Indian companies but our focus is on the subset of companies that have been listed on the two main stock exchanges: "All Companies listed on BSE & NSE Superset' is a set of companies that are or were listed on the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE) at least once even if it merged with another company or ceased to exist at some point in time." This choice ensures that our results are comparable with most published results on corporate innovation (Helmers et al., 2017).

[11] All variables are expressed in nominal terms as we use threshold values which are expressed in nominal terms.

[12] We use current R&D expenses in our main analysis. This is because both GAAP and IFRS accounting systems, which are used in India, specify R&D to be expensed rather than capitalized, with few exceptions. Therefore, R&D capitalization is uncommon for Indian firms. In appendix 11 we show that the results are qualitatively similar if we use the sum of current + capital R&D expenses.

[13] The distribution of patent applications over the years and by the applicant type is shown in appendix 2.

Table 1
Summary statistics.
This table presents the summary statistics of our sample of listed Indian firms from 2010 to 2019. All monetary variables are in million Indian Rupees and winsorized at the 1 % level. All variables are defined in Appendix 1.

Variable	N	Mean	Std dev
Total expenses	76,380	25,063.63	159,352.50
R&D expenses	41,412	360.23	1568.69
CSR expenses	41,412	21.77	46.09
Advertising expenses	41,412	242.42	1326.69
Compensation expenses	76,380	2485.47	17,388.98
Professional services expenses	41,142	7.059	57.04
Depreciation	76,380	990.38	7277.97
Overhead expenses	76,380	728.32	4889.59
Firm size (total assets)	76,380	69,145.77	629,385.70
ROA	76,380	0.05	0.23
Net worth	41,142	13,918.30	83,608.27
Sales turnover	76,380	23,674.06	159,141.20
Profit before tax	76,380	6546.48	50,381.29
Exports (% sales)	41,142	22.78	28.01
Technology imports (% sales)	41,142	18.51	38.19
Raw materials imports (% sales)	41,142	13.08	32.59
Board size	41,142	12.35	7.39
Board Independence	41,142	0.46	0.30
%Shareholding-promoters	41,142	32.09	29.18
%Shareholding-institutions	41,142	18.38	31.77
%Shareholding-foreign	41,142	10.83	33.35
Business groups	41,142	0.32	0.44
Patents	41,142	0.65	0.99
New product announcements	41,142	0.87	0.79
HHI	41,142	0.645	0.18

firms is 0.65 (0.43).

In addition, we collect information on new product announcements from the Lexis Nexis database. We first search Lexis Nexis for Indian firms' press releases combining the keywords "New Products" and "New Brands" with "Launches", "Release," and "Unveil." Next, we extract the new product announcements from January 1, 2010, to December 31, 2019, published in the leading Indian English language newspapers.[14] We have 16,302 new product announcements using this extraction technique within the sample period. We download all such press releases and parse the firm names, identifiers, and the announcement date from the text. We then fuzzy match the names of the patent applicants with the firm names in our sample. Our sample firms launched 35,793 new products. Finally, we count how many times a firm appears in the dataset in a year to create the variable *#New Products Announced*. The median (median) number of new products announced is 0.87 (0.79).

Finally, we use the 2-digit National Industrial Classification (NIC), similar to the SIC codes, to identify the primary industry classification of Indian firms.[15]

3.2. Empirical strategy

We begin our analysis by examining the average effect of the CSR law on Indian firms' CSR expenses. First, we show a marked growth in average CSR expenses of sample firms following the CSR law in Fig. 1.

Next, we take the full sample of listed Indian firms and use a dummy, *Post*, which equals '1' for the years 2014–2019, to estimate the growth of CSR expenses following the implementation of Section 135. We estimate the following regression with a full set of firm-level control groups.

$$Ln(1+CSR) = \beta_1 Post + \beta_2 Bandwidth + \beta_3 Bandwidth \times Post + \delta Z_{it} \quad (1)$$

The main explanatory variable is *Bandwidth* which is a dummy = 1

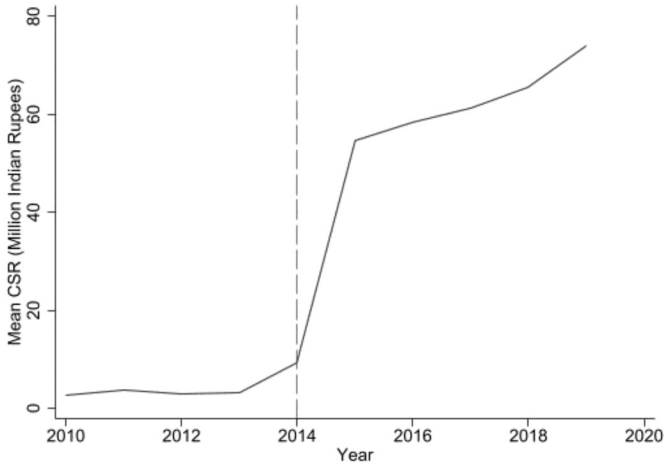

Fig. 1. Section 135 and CSR Expenses of Indian Firms (2010–2019).

for firms in the pre-tax profit bracket of ₹40 million to ₹49 million.[16] *Post* is an indicator for the years 2014–2019. The estimate β_1 captures the change in average CSR expenditure of Indian firms before and after the CSR law, β_2 captures the change in average CSR expenditure of firms closer to the profit threshold compared to those further away and β_3 captures the change in CSR expenditure of firms closer to the threshold before and after the CSR law relative to firms further away from it.[17]

Further, we examine the CSR expenses of innovative firms and firms in innovative industries. We use triple interactions of *Bandwidth* × *Post* dummies and indicators for *Innovative Firms* (which equals '1' if a firm has applied for at least two patents in the 2010–2013 period) and *Innovative Indusries* (which equals '1' if the collective number of patent applications of all firms in that industry between 2010 and 2013 is in the top quartile of the industry-wide patent application distribution). The underlying idea is to examine if innovative firms close to the threshold reduce their CSR expenses relative to non-innovative firms.

Next, we test if firms avoid qualifications for the CSR law. We exploit the discontinuity, or kink, at pre-tax profits, sales turnover, and net worth distributions. The kinks are the threshold values above which the CSR regulation applies to the sample of firms. Bunching as an empirical method has been widely used to examine behavioural responses of firms to corporate taxation (Saez, 2010; Chetty et al., 2011). Chen et al. (2021) use bunching to show how Chinese firms react to fiscal incentives to innovate.

The simplest method to detect bunching is to produce histograms of the distribution of the underlying variable (pre-tax profit in our case) and observe spikes in frequency around the kink points. We begin by taking the subsample of firms below the CSR law's net worth and sales turnover threshold. The CSR law can only apply to these subgroups of firms *if* they cross the profit threshold. We plot histograms of our sample of Indian firms' pre-tax profits for the pre-CSR law (2010–2013) and post-CSR law (2014–2019) periods. We also plot sales turnover and net-worth histograms for the two sub-periods to examine if bunching occurs at these kinks. The plots are presented in Figs. 2 and 3.

Among firms below the sales turnover and net worth thresholds, we find clear evidence of bunching on the left of the pre-tax profit threshold. We see a significantly higher fraction of firms just below the threshold. Similar bunching is not observed at this threshold in the pre-CSR law

[14] We provide the complete list of the newspapers in appendix 14.
[15] We use the NICs from the 2008 update.
[16] We check the robustness of our results with different bandwidths. The results are presented in appendix 7.
[17] In appendix 6, we provide balancing tests to ensure the similarity of treatment and the control group firms on observable characteristics. We find that the only economically meaningful difference between firms in the *Bandwidth* and those further below the threshold is in their R&D expenditure.

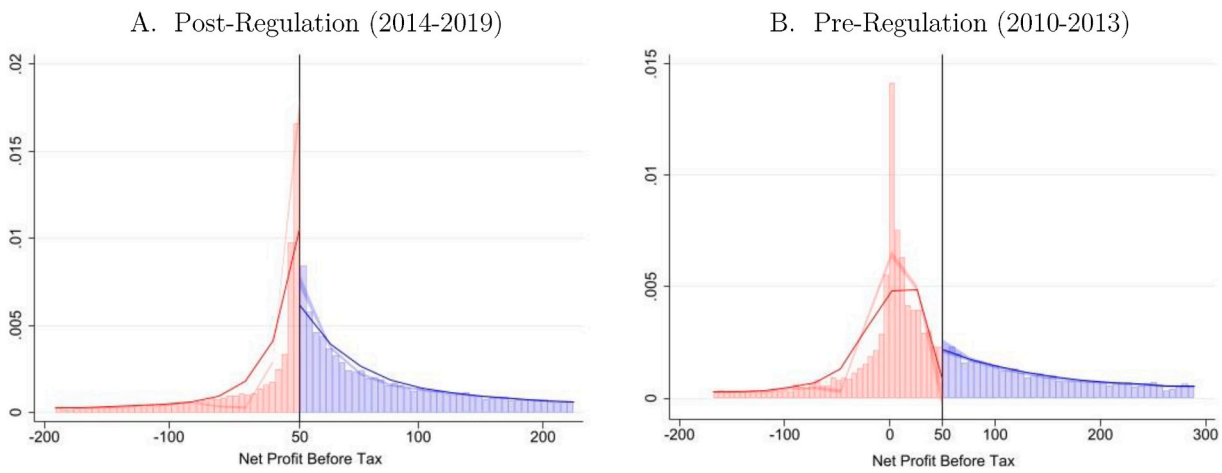

Fig. 2. Bunching at the pre-tax profits threshold after CSR regulation.

subperiod (here, bunching is seen at zero profits), the sales turnover, or the net worth thresholds (before or after the CSR law).[18] These diagrams provide compelling evidence of earnings management at the profit threshold to avoid compliance with the CSR law.

We use a local polynomial density estimation to numerically detect discontinuities at the threshold of the assignment variable (pre-tax profits). The idea of the McCrary (2008) test is that the marginal density of pre-tax profits should be continuous around the threshold without firms manipulating profits. By comparing the density of firms around the pre-tax profit threshold pre- and post-regulation, we can detect earnings management.

Further, we explore how firms reduce pre-tax profits to avoid qualifying for the CSR law. Under the plausible assumption that firms will not reduce sales revenue, we examine if the main forms of corporate expenses increase in the post-regulation period.[19] Specifically, we examine if firms increase R&D expenses around the profit threshold in the post-regulation period. Fig. 4 shows a distinct discontinuity in R&D expenses on the left-hand side of the profit threshold. We show that such discontinuity in R&D expenses around the same threshold is absent in the pre-CSR law sub-period. Furthermore, the placebo diagrams (appendix 4) do not show discontinuities in R&D expenses around the net worth and the sales turnover thresholds. These results highlight the relative ease of manipulating profits compared to net worth and sales turnover and form the basis of our empirical strategy.

We follow up the graphical analysis with multivariate regression models. We start with a pooled cross-section of 2016 firms below the pre-tax profit threshold.[20] Our analysis focuses on firms in the *Bandwidth* (pre-tax profits between ₹40 million to ₹49 million). The control group in these regressions consists of firms further beneath the profit threshold (with pre-tax profits below ₹40 million). We estimate a model with $Ln(1 + R\ \&\ D)$ as the dependent variable and the interaction of *Bandwidth* and *Post* as the main regressor. The following control variables are included: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (also expressed as a percentage of sales), the board size, board independence, shareholdings of promoters, institutions and foreign owners, and a dummy that equals '1' if the firm is a part of a business group. These control variables account for firm characteristics correlated with R&D expenses (Jain and Krishnapriya, 2020). These variables allow us to hold constant variations in firm size, profitability, export orientation, technology inputs, ownership structure, and corporate governance attributes.

We estimate the following model with firm and year-fixed effects (f_i and k_t) and the standard errors clustered at the firm level:

$$Ln(1 + R\&D) = \beta_1 Bandwidth \times Post + \beta_2 Post + \delta Z_{it} + f_i + k_t \quad (2)$$

The estimate β_1 provides the estimates of the effect of the CSR law on R&D expenses of firms closer to the profit threshold, relative to firms further below the threshold.

We also estimate alternate specifications of model (2) to ensure the robustness of our results. We estimate variants of Eq. (2) with different fixed effects structures. Specifically, we estimate models including the *Bandwidth* dummy with industry and year fixed effects and (2-digit) industry-year fixed effects. Naturally, in these models, we exclude firm fixed effects.

A key assumption of these estimates is that the treatment and control groups show similar time trends in the pre-regulation period. In Fig. 5, we provide evidence of that with the time-series plots of pre-tax profits and R&D expenses of the treatment (*Bandwidth*) and the control group (firms further beneath the profits threshold). First, we show that the time series of pre-tax profits for *Bandwidth* and control group firms are similar pre- and post-regulation. It highlights that the regulation was not endogenous to the firms' profits.

Further, we demonstrate that in the pre-regulation period, the time-trend of R&D expenses of firms in the *Bandwidth* and those in the control group are similar. Post-regulation, the average R&D expenses of *Bandwidth* firms increase, whereas that of the control group does not deviate from the pre-regulation trend. This diagram provides evidence of the validity of our multivariate models.[21]

We also estimate regressions analogous to Eq. (2) for other corporate expenses, such as compensation, overhead, professional service costs (audit, consulting, and legal fees), and depreciation.

Finally, we focus on the real innovation outcomes of the increased R&D expenses. For the sample of all firms below the pre-tax profit

[18] We show the bunching diagrams for the sales turnover and net worth thresholds in appendix 3.

[19] The assumption relies on the logic that, since the profit threshold of Section 135 applies in all three years, delaying revenue income is not a viable strategy. A firm that delays sales revenue income for one year to avoid treatment will have to report the delayed income in the next year and, at that stage, the Section 135 will apply. Formally, we show that firms do not engage in earnings management by reducing their income. After the CSR law was enacted, we detect no discontinuity of total income at the pre-tax profit threshold. We present the diagram in appendix 5.

[20] As discussed in the Data section, these firms are also below the sales turnover and net worth thresholds of Section 135.

[21] In appendix 16, we show similar graphs for other corporate expenses. We find no change in time-trends of these expenses for either the treatment or the control group firms post-regulation.

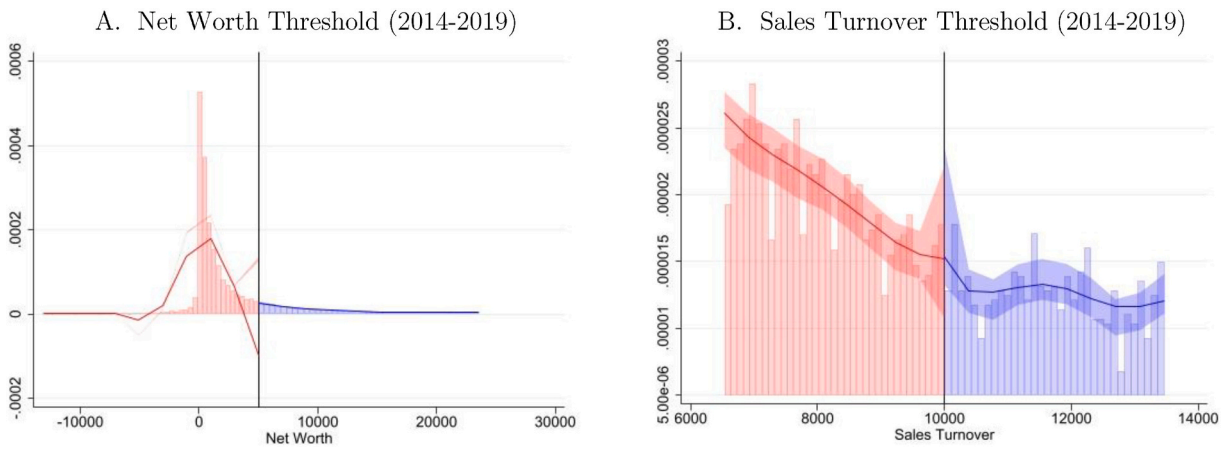

Fig. 3. Bunching at the net worth and sales turnover thresholds after CSR regulation (2014–2019).
Note: The corresponding diagrams for the pre-regulation period (2010–2013) are provided in the appendix.

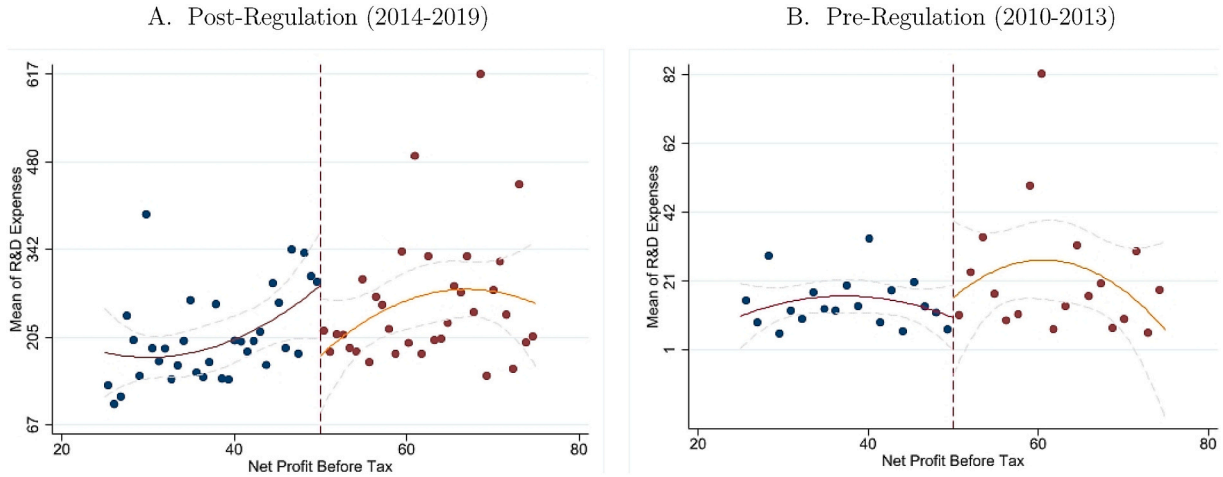

Fig. 4. Discontinuity in R&D expenses at the pre-tax profit threshold.

threshold, we estimate a two-way fixed effects model with *Bandwidth* × *Post*. We focus on two innovation outputs: patent applications and new product announcements. We estimate a model of the following type where Z_{it} is the vector of all firm-level covariates and f_i and k_t are firm and year fixed effects, respectively:

$$\#Patent\ Applications = \beta_1 Bandwidth \times Post + \beta_2 Post + \delta Z_{it} + f_i + k_t \quad (3a)$$

$$\#New\ Products\ Announced = \beta_1 Bandwidth \times Post + \beta_2 Post + \delta Z_{it} + f_i + k_t \quad (3b)$$

We also estimate the effect on innovation outcomes for only those firms in the *Bandwidth* that increase their innovation outcomes following the CSR law. We estimate triple interaction models with $\Delta R\ \&\ D > 0$, which equals '1' if the average R&D expenses of a firm in 2014–2019 exceeded the average R&D expenses of a firm in 2010–2013.[22] We estimate the following model, including the double interaction and level effects.

$$\#Patent\ Applications = \beta_1 Bandwidth \times Post \times \Delta R\&D > 0 + \delta Z_{it} + f_i + k_t \quad (4a)$$

$$\#New\ Products\ Announced = \beta_1 Bandwidth \times Post \times \Delta R\&D > 0 + \delta Z_{it} + f_i + k_t \quad (4b)$$

Eqs. (4a) and (4b) show the innovation outcomes of only the subset of firms that increased their innovation inputs in the post-regulation period. These specifications are, therefore, more suited to calculating the economic effects of the policy on innovation outcomes.

4. Results

4.1. CSR law and CSR expenses

We present the estimates from Eq. (1) in Table 2. In panel A, we use *Ln*(1 + *CSR*) as the dependent variable and show that the average CSR expenses of Indian firms increased in the *Post* period. This result is consistent with Dharmapala and Khanna (2018). However, we find that CSR expenses of firms in the *Bandwidth* do not change in the post-regulation period compared to firms further from the threshold. The *Bandwidth* × *Post* estimate is statistically indifferent from zero. This result shows that firms near the threshold do not change their CSR expenditure relative to firms further below it. The results are qualitatively similar when using only the subsample of firms with non-zero CSR

[22] We estimate two-way fixed effects and triple interaction models rather than a traditional regression discontinuity design because the basic premise of our empirical setup is that firms are endogenously avoiding treatment, and hence the distribution of firms across the threshold is non-random.

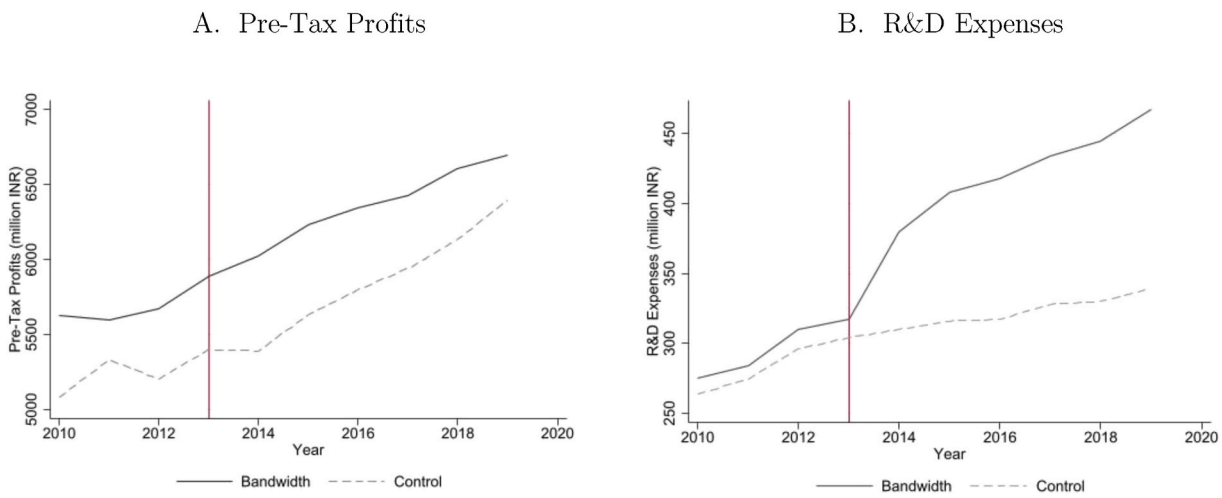

Fig. 5. Pre-tax profits and R&D expense of treatment and control group firms.

Table 2
Section 135 and CSR expenses of Indian firms.
In this table, we show the effect of Section 135 on the CSR expenses of Indian firms. In Panel A, we show the effect of the CSR law on firms close to the threshold by using indicators *Bandwidth* (indicator = 1 if the pre-tax profit is between ₹40 million to ₹49.99 million) and *Post* = 1 for the years 2014–2019. In panel B, we show the effect of Section 135 on innovative companies and firms in innovative industries. The dependent variable in panels A and B is the natural log of 1 + CSR expenses. In panel C, we estimate the model in panel A using the subsample of firms with non-zero CSR expenses. The dependent variable in panel C is natural log CSR expenses. All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and a, and a dummy = 1 if the firm is a part of the business group. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Dependent variable	Panel A	Panel B		Panel C
	Ln (1 + CSR)	Ln(1 + CSR)		Ln (CSR)
	(1)	(2)	(3)	(4)
Bandwidth × post	0.001	0.003	0.003	0.003
	(0.001)	(0.004)	(0.002)	(0.002)
Post	0.033***	0.036***	0.034**	0.039***
	(0.009)	(0.012)	(0.015)	(0.010)
Bandwidth	0.004	0.002	0.001	0.005
	(0.005)	(0.003)	(0.002)	(0.005)
Bandwidth × post × innovative		0.003		
		(0.005)		
Bandwidth × post × innovative industries			0.001	
			(0.002)	
Post × innovative		−0.011*		
		(0.005)		
Post × innovative industries			−0.004**	
			(0.002)	
Control variables	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
N	41,412	41,412	41,142	32,715
R^2	0.249	0.263	0.274	0.299

expenses (panel C). These results highlight that the CSR expenses of the treatment and the control group firms are similar.

In panel B, we use indicators *Innovative Firms* and *Innovative Industries* to examine the effect of CSR law on these firms. We find that the average CSR expenses of innovative firms and firms in innovative industries in the *Bandwidth* are not statistically significantly different from the control group firms. If the CSR regulation leads to a rebalancing of corporate expenses between CSR and R&D, we expect to see the CSR expenses of the innovative firms in the *Bandwidth* fall post-regulation. Our results indicate that firms in the *Bandwidth* do not trade off CSR and R&D expenses. These results indicate that firms in the *Bandwidth* do not trade off CSR and R&D expenses.

4.2. Bunching of pre-tax profits

Table 3 shows the results of the tests for discontinuity at the pre-tax profit, net worth, and sales turnover thresholds. We present the results for the pre-regulation (2010–2013) and the post-regulation (2014–2019) periods. We report the total number of observations on the two sides of the threshold (N_+ and N_-), the effective number of observations, i.e., the number of observations in the narrow bandwidth around the threshold (n_+ and n_-), and the bandwidth (h) of ₹10 million. The test statistic is constructed using a third-order polynomial (q = 3) with bandwidths chosen for an unrestricted second-order polynomial model ($p = 2$).

First, we highlight the difference in the number of observations within ₹10 million on either side of the profit threshold pre- and post-regulation. The number of observations was more balanced in the same profit range pre-regulation compared to the post-period. There are 1890 firms in the narrow profit range below the threshold and 695 firms in the narrow profit range above. This observation pattern further highlights firms' bunching at the pre-tax profit threshold. Additionally, the manipulation test statistic is −43.58 with a *p*-value of 0.000. This implies a statistically significant jump in the density function left of the profit threshold. The discontinuity at the net profit threshold is not present in the pre-regulation period (p-value = 0.247).[23]

Additionally, we do not find any evidence of discontinuity in the distribution at the net worth and sales turnover thresholds in both pre- and post-regulation periods. As discussed in Section 2, consistently manipulating net worth and sales turnover are more difficult than manipulating pre-tax profits.

4.3. CSR law and R&D expenses

Further, we focus on how firms in the bandwidth manipulate earnings to avoid qualifying for the CSR law. In Table 4, we present the estimates of R&D expenses for firms in the *Bandwidth* with firm and year

[23] In appendix 15, we present separate McCrary test plots for each year of the sample period.

Table 3
McCrary test results.
This table presents the McCrary (2008) test results for detecting discontinuity at the pre-tax profits, net worth, and sales turnover thresholds of the Indian CSR law using local polynomial density estimation. We present the number of observations of all firms above and below the thresholds (N_+ and N_-), the number of observations in the narrow bandwidths surrounding the thresholds of the treatment (n_-) and control (n_+) groups, and the test-statistic *p*-values for pre-CSR law (2010–2013) and post-CSR law (2014–2019) differences in mean. The thresholds for pre-tax profits, net worth, and sales turnover are ₹50 million (approximately US$ 695,000), ₹5 billion (approximately US$ 69 million), and ₹10 billion (approximately US$ 149 million), respectively. The bandwidth is ₹10 million.

	2010–2013					2014–2019				
	N_-	N_+	n_-	n_+	p-Value	N_-	N_+	n_-	n_+	p-Value
Pre-tax profits	6239	5996	1235	1309	0.247	13,743	10,323	1890	635	0.000
Net-worth	2548	1069	648	781	0.249	21,381	2880	696	806	0.376
Sales turnover	10,474	3384	542	599	0.416	20,257	6446	615	700	0.621

fixed effects (column 1), industry and year fixed effects (column 2), and industry-year fixed effects (column 3). In theory, all these fixed-effects structures should give comparable estimates under different assumptions. The two-way fixed effects model with firm and year fixed effects works if firm-level unobservable characteristics affect *y* (column 1). On the other hand, the specification without firm fixed effects assumes that firm-level unobservable characteristics do not affect *y* (column 2). The industry-year fixed effects model controls for the unobserved impact of factors unique to industry conditions at specific points in time that can affect firm-level R&D inputs.

In our baseline model, we use firm and year-fixed effects and cluster the standard errors at the firm level. Since some firms remain in the *Bandwidth* for multiple years, they drop out of the estimates with firm fixed effects. It is reflected in fewer observations in column 1 relative to columns 2 and 3. *Bandwidth* × *Post*, is positive and statistically significant at the 1 % level, and the coefficient of *Post* is statistically indifferent from zero. It implies that the average R&D expenses of sample firms did not increase post-regulation. However, R&D expenditure of *Bandwidth* firms increased by 3.6 %. Multiplying this effect size with the mean R&D expense of sample firms gives us an additional ₹13 million in R&D expenses across all firms. In the year-wise coefficient plots, we observe that the increase in R&D expenditure is consistently higher in all post-regulation years compared to the pre-regulation years.[24] These results confirm the hypothesis that firms in the *Bandwidth* increased their R&D expenditure after the CSR law was in effect to avoid qualification.

The results are qualitatively similar in columns (2) and (3) but more precisely estimated (lower standard errors) because of the larger sample size. Together, these results show robust evidence of increased R&D expenses for firms near Section 135's pre-tax profit threshold.[25]

Table 5 provides similar estimates for a range of other corporate expenditure items with the same control variables discussed in Eq. (2). All the dependent variables are in natural logs. We show that corporate expenses such as compensation, overhead, professional service costs (audit, consulting, and legal fees), and depreciation of *Bandwidth* firms do not increase post-regulation.[26]

What explains the increase in R&D expenditure and no other corporate expenses in response to the CSR law? Most corporate expenditures (such as compensation, overhead, and professional service costs) fluctuate with economic conditions. In addition, some of these costs, such as wages and salaries, do not readily adjust downward with changing economic conditions. Therefore, an ad-hoc increase in these expenditures will burden a firm with a sub-optimally high-cost structure in the long run.

Table 4
Section 135 and R&D expenses of firms near the profit threshold.
This table shows the R&D expenditure of all firms below the pre-tax profit threshold (and below the net worth and sales turnover threshold) of the CSR law. The sample size is 2016 companies with 19,639 firm-year observations. The dependent variable in all specifications is the natural log of 1 + R&D expenses. In column 1, we show the effect of Section 135 on the R&D expenses of companies in the *Bandwidth* (indicator = 1 if the pre-tax profit is between ₹40 million to ₹49.99 million in *Post* (indicator = 1 for years 2014–2019)) with firm fixed effects. Column 2 estimates the specification in column 1 with industry and year dummies. Column 3 shows the baseline effect with industry-year fixed effects. All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and business group dummy. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at 1 %, 5 % and 10 % levels, respectively.

Dependent variable	Ln (1 + R&D)		
	(1)	(2)	(3)
Bandwidth × post	0.031**	0.036***	0.025***
	(0.014)	(0.009)	(0.008)
Bandwidth		0.009	
		(0.013)	
Post	0.021	0.020	0.013
	(0.019)	(0.016)	(0.009)
Control variables	Yes	Yes	Yes
Firm fixed effects	Yes	No	No
Year dummies	Yes	Yes	No
Industry dummies	No	Yes	No
Industry-year fixed effects	No	No	Yes
N	16,244	19,639	19,639
R^2	0.344	0.144	0.227

4.4. Heterogeneous treatment effects

The incentive to avoid qualifying for the CSR law by increasing R&D expenses will depend on the firm's characteristics. Therefore, we examine what kind of firms increase R&D expenses. Specifically, we focus on whether the firm has a history of innovation and is in an innovative industry. We use R&D expenditure and the stock of patent applications made in the pre-regulation period (2010–2013) to classify innovative firms. We focus on past innovation because the expected value of incremental innovation expenses is higher for these firms than those with no innovation history.

Table 6 presents the estimates from the triple difference models where we interact *Bandwidth*, *Post*, and the dummies of *Innovative Firm* and *Innovative Industry*. The sample used in these models includes all firms below Section 135's profit threshold. All specifications include the level effects and the two-way interactions. Consistent with our hypothesis, we find that innovative firms increased their R&D expenses post-regulation compared to non-innovative firms. Similarly, we find firms in innovative industries increase R&D expenses relative to firms in non-innovative industries.

[24] We present the graph in appendix 18.
[25] All firms that engage in the Bandwidth may not engage in real earnings management and therefore our results is likely to be a lower-bound of the true-effect.
[26] The results are similar if we use industry-year fixed effects instead of firm and year fixed effects. We show the results in appendix 17.

Table 5
Section 135 and other corporate expenses near the profit threshold.
This table shows Section 135's effect on the corporate expenditure of all firms below the CSR regulation's pre-tax profit threshold (and below its net worth and sales turnover thresholds) of the CSR law. The sample size is 2016 firms with 19,639 firm-year observations. The dependent variable in all columns is reported in the first row. All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and a dummy that equals one if the firm is a part of the business group. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at the 1 %, 5 %, and, 10 % levels, respectively.

Dependent variable	Ln (compensation expenses)	Ln (advertising expenses)	Ln (depreciation)	Ln (overhead expenses)	Ln (professional services expenses)
	(1)	(2)	(3)	(4)	(5)
Bandwidth × post	0.011	−0.009	0.015	0.003	0.001
	(0.010)	(0.008)	(0.012)	(0.005)	(0.002)
Post	0.108	0.057	0.052	0.017	0.020
	(0.090)	(0.041)	(0.035)	(0.022)	(0.016)
Control variables	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
N	16,224	16,224	16,224	16,224	16,224
R^2	0.128	0.139	0.109	0.119	0.091

Table 6
Heterogeneous treatment effects.
This table shows the R&D expenditure of all firms below the pre-tax profit threshold (and below the net worth and sales turnover threshold) of the CSR regulation. The sample size is 2016 firms with 19,639 firm-year observations. The dependent variable in all specifications is the natural log of 1 + R&D expenses. Columns 1 and 2 show the effect for innovative firms (indicator = 1 if a firm has applied for at least two patents in the 2010–2013 period) and firms in innovative industries (dummy = 1 if the collective number of patent applications of all firms in that industry between 2010 and 2013 is in the top quartile of the industry-wide patent application distribution), respectively. *Bandwidth* is an indicator = 1 if the pre-tax profit is between ₹40 million to ₹49.99 million, and *Post* is an indicator = 1 for 2014–2019. Columns 3 shows the CSR regulation's effect on firms with no previous innovation inputs; *No Previous R&D* is an indicator = 1 if a firm has no R&D expenses in the 2010–2013 period. Columns 4–6 show the effect for large firms (in the top quartile of size distribution), manufacturing firms, and business group firms, respectively. All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and a dummy = 1 if the firm is a part of the business group. All specifications also include the level effects and the two-way interaction of *Bandwidth* × *Post*. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Dependent variable	Ln (1 + R&D)					
	(1)	(2)	(3)	(4)	(5)	(6)
Bandwidth × post × innovative firms	0.047***					
	(0.016)					
Bandwidth × post × innovative industries		0.033***				
		(0.010)				
Bandwidth × post × no previous R&D			0.011			
			(0.008)			
Bandwidth × post × large firms				0.017**		
				(0.008)		
Bandwidth × post × manufacturing firms					0.025**	
					(0.011)	
Bandwidth × post × business group						0.002
						(0.003)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Level effects and two-way interactions	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	19,639	19,639	19,639	19,639	19,639	19,639
R^2	0.155	0.201	0.134	0.277	0.196	0.148

Next, we examine if firms with no innovation history start doing R&D following the CSR law. *No Previous R & D* is a dummy that equals '1' if the firm had no R&D expenditure 2010–2013 (411 firms). We show that *Bandwidth* firms with no previous innovation history do not increase their R&D expenses post-regulation. These results corroborate the hypothesis that the CSR regulation only incentivizes the more innovative firms to scale up R&D expenses. We show the result in column 3 of Table 6.

Together, these results indicate that the effect of the CSR regulation on R&D activities is on the intensive margin (where already innovating firms increase their innovation activities) but not on the extensive margin (where firms uninvested in innovation start to innovate). These results highlight firms' strategic choices based on the relative costs of complying with the CSR law and increasing R&D expenditure.

A firm will decide on its CSR and R&D based on the present value of the long-term returns from these expenses. For firms with a history of innovation, the fixed cost of setting up the R&D infrastructure is already incurred, and the expected value of R&D's impact on future profitability is positive (Curtis et al., 2020; Bloom et al., 2016). These firms will perceive the expected future cash flow from R&D to be strictly greater than CSR expenses (given that mandatory CSR dilutes the strategic gains from investing in it). Therefore, we see the effect of the CSR regulation on the intensive margin (innovative firms scale up their innovation activities). On the other hand, for firms with no history of innovation, setting up R&D infrastructure is likely to be at least as costly as CSR compliance. These firms would have already invested in R&D pre-regulation if it were optimal for them to do so. Therefore, the least inefficient option for these firms is to comply with the CSR regulation.

This explains our result on the extensive margin (why firms with no innovation history do not incur R&D expenses to avoid the CSR regulation).

Further, we examine if the effect of the CSR regulation on R&D expenses is concentrated in firms with certain attributes. In columns 4–6 of Table 6, we show that large firms (firms in the highest quartile of the asset distribution of sample firms) and manufacturing firms in the bandwidth increased R&D expenses post-regulation. We also find that business group affiliation does not seem to play a statistically significant role. These results imply that the effect of the CSR regulation on R&D expenses is localized in firms that are more likely to have an established innovation strategy. These results underscore our results on the intensive margin.

4.5. Effects on innovation outcomes

Finally, we focus on the tangible innovation outcomes of the increased R&D inputs for *Bandwidth* firms. One issue with focusing on R&D expenses is that firms can relabel other administrative expenses without investing them productively (Chen et al., 2021). In that case, there should be no impact of increased R&D expenses on innovation outputs, such as patent filing and new product announcements.[27] Therefore, we examine if *Bandwidth* firms that increase R&D expenses post-regulation have higher innovation outputs.

We present two sets of evidence. In panel A of Table 7, we show the two-way fixed effects results with firm and year fixed effects. *Bandwidth* firms, on average, filed one extra patent application in the 2014–2019 period. These firms also announced 1.5 new products in the post-regulation period. The results in panel A show the average effects for all *Bandwidth* firms, irrespective of whether they increased R&D expenditures following the CSR regulation. If there are firms in the *Bandwidth* that did not increase R&D expenditure following the CSR regulation, our estimates will be downward biased. These results are qualitatively similar when we use Poisson regression and zero-inflated negative binomial models.

Therefore, we estimate a triple interaction model focusing on only those firms in the *Bandwidth* that increased their R&D expenditure after the CSR regulation. The estimate on the triple interaction of *Bandwidth* $\times$ *Post* $\times$ $\Delta R \,\&\, D > 0$ is positive and statistically significantly higher than the estimates in panel A (p-value = 0.000). *Bandwidth* firms that increased R&D expenditure post-regulation filed 1.3 additional patent applications and announced two new products compared to those that did not increase their R&D expenditure. These results may not have a causal interpretation, but they provide indicative evidence of positive innovation outcomes for firms that increase R&D expenses to avoid Section 135.

4.6. Extensions and robustness

We check if our reported results are robust to obvious confounding factors and methodological choices. Indian R&D tax-credit incentives have undergone revisions within our sample period (Ivus et al., 2021). An important concern is that other unobserved industry-level factors related to the tax-credit incentives explain our observed effects. In particular, the impact of R&D tax credits on R&D expenses varies by industry. Since higher R&D tax credits can motivate firms to invest more in R&D, it can confound our results (Bloom et al., 2019).

First, we note that the R&D tax credits in India have become less generous over time (Ivus et al., 2021). Therefore, the effect of R&D tax credits should reduce the R&D expenses of our sample firms. Notwithstanding this theoretical reasoning, we estimate the baseline models

Table 7
Innovation outcomes of firms avoiding Section 135.
This table shows the results for increasing R&D expenditure on innovation outcomes for firms below the profit threshold of Section 135. In panel A we present the two-way fixed effects results, and panel B presents the triple interaction results. The dependent variable in columns (1) and (3) is the number of patent applications made, and in columns (2) and (4), it is the number of new products announced by a firm in the 2014–2019 sub-period. *Bandwidth* is an indicator = 1 if the pre-tax profit is between ₹40 million to ₹49.99 million; *Post* is an indicator = 1 for 2014–2019. $\Delta R\&D > 0$ is an indicator = 1 if a firm's average R&D expenses in 2014–2019 > the average R&D expenses in 2010–2013. All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and a dummy = 1 if the firm is a part of the business group. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at the 1 %, 5 % and 10 % levels, respectively.

	Panel A		Panel B	
	Patent applications	New product announcements	Patent applications	New product announcements
	(1)	(2)	(3)	(4)
Bandwidth × post	1.008**	1.534**	0.098	0.081
	(0.445)	(0.706)	(0.054)	(0.067)
Bandwidth × post × ΔR&D > 0			1.356***	2.004***
			(0.380)	(0.619)
ΔR&D > 0			0.376**	0.281**
			(0.162)	(0.133)
Post × ΔR&D > 0			0.028	0.033
			(0.019)	(0.021)
Bandwidth × ΔR&D > 0			0.011	0.003
			(0.007)	(0.002)
Bandwidth			0.019	0.103
			(0.018)	(0.088)
Post	0.166	0.154	0.139	0.176
	(0.129)	(0.115)	(0.116)	(0.150)
Control variables	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	No	No
Industry dummies	No	No	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N	16,224	16,224	19,639	19,639
R^2	0.309	0.274	0.281	0.259

with industry-year fixed effects. These fixed effects should subsume unobserved factors affecting firms in a specific industry over time. In column 3 of Table 4, we have shown that the results are qualitatively similar to the baseline estimates when using industry-year fixed effects.

We also estimate our baseline models for sectors that enjoy preferential innovation incentives from the government. We use a dummy, *Preference Sector*, which equals '1' if the main industry classification of a firm is biotechnology, pharmaceuticals, and energy, to estimate our main models. If incentives other than the CSR regulation drive our results, then introducing the *Preference Sector* dummy will attenuate our baseline estimates. In column 1 of Table 8, we show that our baseline results remain robust to adding the *Preference Sector* dummy in our regression models.

Our baseline results can also be confounded by unobserved changes in export market conditions and equity ownership patterns. To address this concern, we estimate our baseline models with firm fixed effects and controls for corporate ownership structure (%*Shareholding* of different investor groups). However, we also explicitly examine the R&D expenses of *Bandwidth* firms with a high export market and foreign

[27] In our setting, even if firms are engaging in relabelling other expenses as R&D, it is difficult to theorise as to why such behaviour will change after the CSR regulation came into effect.

Table 8
Test for confounding factors.
This table shows the tests for confounding factors. The dependent variable in all columns is *Ln(1 + R&D)*. In column 1, we present the results with additional control for the *Preference Sector* (dummy = 1 if the primary industry classification of a firm is biotechnology, pharmaceuticals and energy). In columns 2 and 3, we show the effect of R&D expenses for firms with *High FII* (dummy = 1 for firms in the top quartile of FII distribution) and *High Exports* (dummy = 1 for firms in the top quartile of exports distribution). All specifications include the following controls: firm size, ROA, log of total assets, exports (as a percentage of sales), technology imports and raw materials imports (as a percentage of sales), board size, board independence, shareholdings of promoters, institutions and foreign owners, and a dummy = 1 if the firm is a part of the business group. All specifications also include the level effects and the two-way interaction terms of the main explanatory variables. All variables are defined in Appendix 1. Standard errors are clustered at the firm level. ***, **, and * represent statistical significance at the 1 %, 5 % and 10 % levels, respectively.

Dependent variable	Ln (1 + R&D)		
	(1)	(2)	(3)
Bandwidth × post	0.030**	0.033**	0.033***
	(0.013)	(0.012)	(0.010)
Preference sector	0.009*		
	(0.005)		
Bandwidth × post × high FII		0.008	
		(0.006)	
Bandwidth × post × high exports			0.010
			(0.014)
Level effects and two-way interactions	Yes	Yes	Yes
Control variables	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
N	19,639	19,639	19,639
R^2	0.238	0.273	0.397

investor exposure. In columns 2 and 3, we show that the triple interaction terms of *Bandwidth*, *Post*, and indicators for *High Export* (indicator = 1 if a firm is in the top quartile of the distribution of export/sales) and *High FII* (indicator = 1 if a firm is in the top quartile of the distribution of the fraction of foreign institutional ownership). We show that the triple interaction terms are not statistically significant, but the coefficient of *Bandwidth* × *Post* remains positive and statistically significant. Therefore, exposure to export markets and foreign institutional investors does not seem to drive our baseline results.

Next, we present a range of robustness tests in the supplementary appendices. In appendix 7, we show that our results hold for a different choice of bandwidths around the pre-tax profits threshold: ₹45 million to ₹49 million and ₹35 million to ₹49 million. Next, we use a continuous *Distance to Threshold* (the difference between the firm's pre-tax profits and ₹49 million) measure instead of the *Bandwidth* dummy. We find that as the distance to the threshold decreases, R&D expenses increase. Therefore, our results are not statistical artefacts of the *Bandwidth* construction.

In appendix 8, we show that there is no increase in R&D expenses of firms near the net worth and the sales turnover thresholds of Section 135. This result is consistent with the evidence of a lack of bunching at these thresholds presented in Table 3. It is important to note that increasing R&D expenses will not likely help firms at the net-worth and sales revenue thresholds to manipulate their CSR-law qualification since R&D expenses do not directly affect these variables.

Next, we show yearly estimates of corporate innovation outcomes in appendix 9. We interact the $\Delta R \ \& \ D > 0$ with year dummies to examine the temporal nature of the average effect. We show that increased R&D expenses following the CSR regulation show up in the patent applications in 2018 and 2019, whereas the impact on new product announcements shows up from 2017 onwards. The lag in the innovation outputs is consistent with long gestation periods of innovation projects.

Further, we examine the robustness of our results to sampling and empirical specification choices. First, about a fifth of the firm-year observations has zero R&D expenses. A large fraction of zero in the dependent variable can introduce bias in our estimates. Therefore, we provide results using econometric methods and variable transformations most suitable for this data property. We show that estimates from Poisson Pseudo Maximum Likelihood Method (PPML) regressions and using Inverse Sine Hyperbolic Transformation of the dependent variable are similar to the baseline. Our results are also unchanged in the subsample of firms with non-zero R&D expenses. We show the results in appendix 10.

In our baseline specifications, we exclude capital R&D expenses for reasons noted in footnote 14. In an alternate specification, we estimate our baseline models with capital R&D expenses and the sum of capital and current R&D expenses. Appendix 11 shows that these specifications yield comparable results to our baseline estimates. We also estimate our baseline models with an extended sample of all firms listed in the BSE and NSE from 2008 to 2019. Our results remain similar to those reported in Table 4.

In additional results, we show the effect of the CSR regulation on other forms of technology adoption. Specifically, we focus on the three most commonly available indicators in Prowess for our sample: Capital Good Imports, Intermediate Input Imports and Licensing fees. In appendix 12, we show that *Bandwidth* firms increased capital good imports post CSR regulation compared to control group firms. The increase in capital good imports is consistent with the rise in R&D expenditure - innovative firms procure more capital goods to boost their R&D activities. However, we find no statistically significant effect for intermediate input imports and licensing fees.

Finally, in appendix 13, we present the results from a fully nested model in which the *Bandwidth* covariate is interacted with all covariates. The idea is to isolate the effect of the regulation on R&D expenses, holding constant all parameters on which *Bandwidth* firms differ from the control group. The result from this stringent empirical specification is similar to our baseline estimates.

5. Conclusion

This paper shows that public policies on corporate social responsibility positively affect corporate innovation. Indian CSR law mandates Indian firms exceeding a certain profit threshold to spend 2 % of their pre-tax profits on CSR. We show that firms close to the regulation's profit threshold attempt to avoid qualifying by engaging in earnings management and reporting lower profits. Furthermore, we demonstrate that these firms reduce pre-tax profits beneath the threshold by increasing R&D expenses. The increase in R&D expenses has tangible innovation impacts in the following years. Firms proximate to the threshold that increases R&D expenses apply for one additional patent and announce two new products in the next three years than similar firms that did not increase their R&D expenses. This effect is particularly pronounced in firms with a prior history of innovation and firms in innovative industries.

Our results have direct implications for public policies that aim to foster innovation. One major concern in innovation policy is that the information about the motives and outcomes of corporate R&D initiatives is imperfect. Firms can, and do, relabel other operational expenses as R&D to take advantage of fiscal incentives for innovations like R&D tax credits. Therefore, direct fiscal incentives to innovate can incentivize misleading information about innovation activities. Our results show a pathway through which indirect incentives generated by social policies can foster “real” innovation without such relabelling concerns. In this case, only the more innovative firms scale up their R&D expenses, whereas the less innovative firms will have a stronger incentive to comply with the social policy. Our results thus highlight a novel pathway towards tangible corporate innovation.

CRediT authorship contribution statement

Swarnodeep Homroy: Conceptualization, Methodology, Data curation, Writing - Original draft preparation. **Shubhashis Gangopadhyay**: Theoretical Framework, Writing - Reviewing and Editing.

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.

Data availability

Data will be made available on request.

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Appendix A. Supplementary tests

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