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Social and Environmental Regulations and Corporate Innovation

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Abstract: In this study, we investigate the effects of mandatory social and environmental regulations (MSER) on firm innovation. In 2008, the Shanghai and Shenzhen Stock Exchange in China published regulations that mandate some public firms to disclose their social and environmental governance information in their annual reports. As the MSER apply only to selected firms, this provides an ideal setting for us to observe the effects of MSER on firm innovation. Using a difference-in-differences with propensity-score-matching methodology, we find that the treatment firms experience a significant increase in innovation in terms of the number of total patents and invention patents. More importantly, we further explore three possible mechanisms underlying this association, that is, the corporate social responsibility (CSR)-improving effect, information-disclosing effect, and market-reaction effect, and demonstrate that this positive relationship is mainly driven by the CSR-improving effect and market-reaction effect, manifesting in an improvement in CSR performance and a decline in transient institutional investors for the treatment firms, respectively.

Keywords: mandatory disclosure; difference-in-differences; CSR performance; institutional investors

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1. Introduction

Corporate social responsibility (CSR) has become an important topic that has attracted significant attention not only from academic scholars but also from business practitioners and governments. For example, Europe enacted the Non-Financial Reporting Directive (NFRD) in 2014, which requires public companies with more than 500 employees to disclose the methods through which they manage social and environmental challenges [1]. The Indian government passed a new law that requires specific firms (according to firms' profitability, net worth, and size) to spend at least 2% of their net income on CSR each year [2]. In China, in 2008, the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) published regulations that mandate some public firms to disclose their social and environmental governance information in their annual reports. Previous studies have examined the effects of mandatory social and environmental regulations (hereafter, MSER) on business operations such as firm performance, shareholder value, and CSR expenditure [2–5].

However, we have little knowledge about how the MSER have impacted firms' other important activity—innovation. Innovation is a dominant corporate strategy that boosts long-term growth and enhances sustainable competitiveness [6,7]. In 2018, PwC surveyed 1000 public firms around the world and found that these firms spent a total of USD 782 billion on innovation activities [8]. Moreover, a report suggests that innovation-related activities account for around 50% of a country's total GDP growth, with their effects varying depending on the level of economic development and the phase of the economic cycle of each country [9]. Accordingly, it is necessary and paramount to investigate whether firm innovation activities are affected by the local government's sudden implementation of MSER.

The relationship between MSER and firm innovation is not immediately clear. On the one hand, such mandatory regulations may lead to a reduction in investment in innovation activities, especially for small- and medium-sized enterprises (SMEs). This is because the affected firms may allocate parts of their available funding, which could be used on innovation projects, to investment in social and environmental governance, thereby causing a decline in the innovation activities. For SMEs whose financial resources are limited [10], their R&D expenditures would rapidly shrink once they are forced by the government to conduct environmental and social activities. On the other hand, MSER may also increase innovation. First, the improvement in CSR performance driven by the regulations may enhance employees' satisfaction, teamwork, and innovative productivity (i.e., CSR-improving effect), which consequently sparks innovation output [11,12]. Second, disclosing non-financial information allows a firm to increase its transparency and reduce uncertainty and information costs (i.e., information-disclosing effect), thereby possibly prompting firm innovation [13–15]. Third, MSER may encourage innovation by reducing the pressures on managers to pursue short-term benefits [16–19], as myopic investors treat these regulations as a negative sign and escape from these firms (i.e., market-reaction effect) [2,3]. Therefore, we attempt to answer the following questions in this study:

- RQ1: How do mandatory social and environmental regulations influence corporate innovation?
- RQ2: What are the underlying mechanisms that drive this relationship?

A Chinese policy provides an ideal setting to identify the causal effect between MSER and firm innovation. At the end of 2008, the SSE and SZSE announced regulations that require certain firms to disclose social and environmental governance information. Since the regulations were unexpected for Chinese firms and only covered some public firms, this provides a quasi-experimental context that can help us accurately estimate the impact of MSER. We leverage this exogenous variation and adopt difference-in-differences with propensity-score matching (DID-PSM) to identify the impact of MSER on firm innovation. We found that MSER led to a significant increase in the firm innovation output measured by the number of patents in the post-regulation period. Specifically, the treatment firms experienced a higher innovation output than the control firms by 19.7% three years after the regulations. The results also revealed that the number of invention patents that were more innovative and original from the treatment firms significantly increased following the regulations, relative to the control firms. Thus, the increase suggests a positive impact on innovation quality. The findings hold up to a variety of robustness checks.

To understand the underlying mechanisms of this association further, we explored the three possible channels proposed above. First, we examined whether CSR performance of the treatment firms was enhanced after the regulations. Prior studies have suggested that the improvement in CSR performance would facilitate firm innovation by increasing the work atmosphere and employee satisfaction [11,12,20]. Our regression results revealed that the CSR performance of the treatment firms increased significantly compared to the control firms. Thus, this supports the mechanism of the CSR-improving effect. Second, we examined whether the information asymmetry of the treatment firms declined after the regulations. MSER may reduce firms' environmental uncertainty and information asymmetry by disclosing more information to stakeholders, thereby eliminating the transaction costs to prompt innovation [15,21]. Ref. [13] also documented that high transparency (i.e., low uncertainty and information asymmetry) facilitates innovation by reducing information costs. If a firm becomes more transparent, an analyst's forecast will be more accurate [22]. Therefore, we adopted the analysts' forecast errors to capture the information asymmetry. The results showed that these errors did not drop significantly for the treatment firms after the regulations, thus suggesting that the positive effect of the regulations on innovation was not driven by the information-disclosing effect. Last, we examined whether the pressures on managers to reap short-term benefits were reduced after the regulations. The extant literature documents that the pressures on short-term benefits from institutional investors stifled firm innovation [16–19]. Accordingly, we explored how institutional ownership changed when firms were affected by MSER. Our regression results indicated that institutional ownership declined significantly for the treatment firms after the regulations.

Thus, this supports the market-reaction effect. In sum, these results revealed that the effects of MSER on firm innovation were primarily driven by the CSR-improving effect and market-reaction effect.

This study is mostly related to Hong et al. [23] and Mbanyele et al. [24] who investigated the impact of mandatory CSR disclosure on firms' green innovation. Although their research provided us with initial insight into the relationship between MSER and green innovation, we do not know how much MSER have impacted firms' whole innovation activities (e.g., non-green innovation). Moreover, previous research did not address why these types of regulations would impact firm innovation activities and output. Accordingly, this study contributes to the literature by examining the impact of MSER on firms' whole innovation output and also provides deeper insights into the underlying mechanisms that explain why the regulations would impact innovation activities.

2. Literature Review

2.1. Government Policy and Corporate Innovation

Our research is related to the literature about how macro country characteristics, such as laws and policies, affect corporate innovation. Conventional policies, such as intellectual property protection [25–27], bankruptcy laws [28,29], universal demand laws [30–32], internet blockade orders [33], emissions trading scheme pilots [34], and antitrust laws [35], have been well studied. Recently, a growing number of studies have focused on the policies that aim to protect the interests of employees and investigated how these laws affect the incentives to innovate [36]. For example, ref. [37] estimated the impact of wrongful discharge laws, which protect employees against unjust dismissal, on innovation. Using the staggered adoption of wrongful discharge laws across U.S. states, they found that the laws indeed had a positive impact on innovation and new firm creation. Ref. [38] revealed a positive causal effect between the passage of smoke-free laws, which banned smoking in workplaces, and corporate innovation measured by patents and patent citations. Ref. [11] examined the effect of state-level stakeholder orientation policies, known as constituency statutes, which allow directors to consider the interests of stakeholders such as employees when making business decisions, on firm innovation. Although prior studies have focused on employee protection laws, the direct effect of MSER on innovation remains unclear.

2.2. Mandatory Non-Financial Disclosure

The last strand of literature is related to mandatory non-financial disclosure. Non-financial disclosure usually refers to the disclosure of CSR- or ESG-related reports. Research on accounting has demonstrated that voluntary non-financial disclosure reduces firms' cost of equity capital, finance, and information asymmetry [22,39,40]. Although an increasing number of firms are willing to disclose non-financial information, a large proportion of companies are still averse to such disclosures. Therefore, several countries and regions have passed laws to mandate public firms to disclose their non-financial information. Ref. [41] investigated the stock market reaction to the passage of the NFRD in Europe and documented that the market reacts negatively to these types of events on average. Ref. [5] examined the impact of mandatory CSR reporting regulations on firms' disclosure practices and valuations using a sample from Denmark, Malaysia, China, and South Africa. They revealed that the disclosure behavior and Tobin's Q of the affected firms increased following the regulations. Similarly, ref. [3] examined whether mandatory CSR disclosure impacted firms' performance and social externalities and observed that the treatment firms experienced a significant decrease in profitability subsequent to the regulations. However, the extant literature did not document the association between mandatory CSR reporting and corporate innovation, which is important for policymakers and firms' managers considering the role of innovation. Therefore, this study contributes to this literature by examining the impact of MSER on innovation.

3. Data and Methodology

3.1. Background

In China, the SSE announced on 30 December 2008 that firms listed in its "Corporate Governance Index" were required to disclose social and environmental governance information in their annual reports beginning in 2008. On 31 December 2008, the SZSE also released a similar announcement that required all firms on its "Shenzhen 100 Index" to disclose social and environmental governance information. Given that the SSE and the SZSE are owned by the Chinese government, the announcements were consistent with the regulations published by the government. Specifically, the SSE Corporate Governance Index consists of 230 listed companies that use best governance practices, which are usually reflected in the total market value, free-float market value, and share turnover. Similarly, the SZSE 100 index is composed of the top 100 listed firms in terms of market value, free-float market value, and share turnover. Although the regulations only required the affected firms to disclose social and environmental governance information, prior research shows that the regulations have led to substantial changes in firms' activities such as environmental improvements [3] and increases in CSR expenditure [4]. Moreover, this requirement is mandatory for these firms. Accordingly, we leverage this exogenous variation to investigate the impact of mandatory social and environmental regulations on firm innovation. Considering the rules of the SSE Corporate Governance Index and SZSE 100 Index, the treatment firms in our research cannot be randomly assigned. Therefore, to mitigate this concern, we refer to the identification strategy that has been widely used in previous research [3,4,42] and utilize DID-PSM methodology to identify the impact of MSER.

3.2. Data

The sample consists of all A-share firms listed on the SSE and the SZSE from 2006 to 2011. We first excluded firms pertaining to financial service industries (i.e., banking and insurance industries), given that these firms are subject to different regulations. Next, we excluded firms that had non-positive shareholders' equity in our sample period because these firms do not have a normal operating environment. Moreover, a few firms that voluntarily disclosed social and environmental governance information before the announcement of the regulations were dropped from our sample, as this study mainly focuses on the influence of mandatory regulations on firm innovation. Finally, we removed firms that only appeared in the pre-regulation or post-regulation periods. Table 1 presents the steps for organizing data. The above selection criteria yielded an initial sample of 6670 firm-year observations (1145 unique firms), where the treatment group consisted of 1595 firm-year observations representing 267 treatment firms and the control group consisted of 5075 firm-year observations representing 878 control firms. We obtained the firm-level financial information from the China Securities Markets and Accounting Research (CSMAR) database.

Table 1. The Processes of Data Organization.

	Process	Observations
Step 1	Exclude firms pertaining to financial service industries;	10,596
Step 2	Exclude firms that have non-positive shareholders' equity;	9812
Step 3	Drop firms that voluntarily disclose social and environmental governance information;	7762
Step 4	Remove firms that only appear in the pre-regulation or post-regulation periods.	6670

Note: The observations in the initial sample size were 10,787.

3.3. Variable Measurement

Dependent Variables. To measure firm innovation, we followed common practices in the innovation literature and constructed the metrics, e.g., in [11,13,14,16]. First, we used the patent-based measure to capture the corporate innovation output, that is, the natural logarithm of one plus the number of patents that the firm has filed (*LnPatents*). More precisely, this variable only counts the annual number of filed patent applications that were eventually granted. As China's State Intellectual Property Office (SIPO) does not require the citation of all related patents when applying for a patent, Chinese patent filing has a well-known problem, that is, a lack of patent citation information [27,34,43], Accordingly, we used the natural logarithm of one plus the number of invention patents (*LnInventions*), which are more innovative and original, to reflect the quality of the innovation output.

Following the practices used in previous innovation research [27,34,43], we combined the number of invention and utility patents as the firm's innovation output. We collected the number of patents for all public firms from the CSMAR database. In total, 108,969 patents were filed in the sample period including 48,663 invention patents and 60,306 utility patents.

Control Variables. In our regression model, we referred to prior research to control for a vector of firm-level characteristics that may influence innovation [11,16]. All control variables were collected from the CSMAR database. Specifically, we controlled for*firm size*, *firm age*, *return on assets (ROA)*, *leverage*, *cash holdings*, and *R&D intensity*. Firm size is the natural logarithm of total assets. Firm age is the natural logarithm of the number of years since the firm's inception. ROA is the ratio of net income to total assets. The leverage ratio is the total liabilities divided by the total assets. Cash holdings is the ratio of cash to total assets. R&D intensity is calculated as the R&D investment, which is collected from the annual report of each firm, scaled by the total assets. To control for outliers, we winsorize all continuous control variables at the 1st and 99th percentiles of their empirical distributions, i.e., data above (below) the 99th (1st) percentile are set to the 99th (1st) percentile. The definitions of all variables used in this paper are presented in Table A1.

3.4. Methodology

Difference-in-Differences. To explore how MSER affect firm innovation, we adopted a DID approach based on the exogenous regulations in China. The logic here was to compare the relative difference between the treatment group and the control group before and after the exogenous shock. One important presumption for this estimation is the satisfaction of "parallel trends" between the treatment and control groups (we discuss this later). In this way, we can control for unobservable sources of heterogeneity across groups. If MSER facilitate firm innovation, we expect to observe that the difference in the increase in innovation between the treatment and control firms was more salient in the post-regulation period than in the pre-regulation period.

Given that the MSER were announced at the end of 2008 (30 December 2008 for SSH and 31 December 2008 for SZSH), we set 2009 as the first year the policy began to influence the treatment firms' behavior. Thus, we selected 2009 to 2011 as the post-regulation period and 2006 to 2008 as the pre-regulation period. We opted for a three-year window for two reasons: (i) the range should not be too short because time is necessary to determine the effect of the event on the innovation outputs; and (ii) it should not be too long to avoid confounding events. We also varied the length of the observation window in robustness analyses. Our specification model is as follows:

$$Innovation_{it} = \alpha_0 + \alpha_1 Treated + \alpha_2 Post + \alpha_3 Treated \times Post + \gamma \mathbf{X_{it}} + I_j + \varepsilon_{it}, \quad (1)$$

where i denotes firms; t denotes years; and j denotes industries. The dependent variable in this model is our measure of a firm's innovation output (i.e., *LnPatents* and *LnInventions*). *Treated* is a dummy variable that is equal to one for the treatment firms and zero for the control firms. *Post* is a dummy variable that equals one if a firm year belonged to the post-regulation period (2009–2011) and zero if a firm year belonged to the pre-regulation period (2006–2008). $\mathbf{X}$ is the vector of the control variables, which included firm size, firm age, ROA, leverage, cash holdings, and R&D intensity. We also included the industry fixed effects (I_j) to absorb the industrially time-invariant differences that were not captured by firm characteristics. ε is the error term. To account for the serial correlation of the error term, we clustered standard errors at the firm level. The coefficient of interest is α_3, which measures the effect of MSER on innovation.

Propensity-Score Matching. To mitigate the differences between the treatment and control firms, we generated a matched control sample using the PSM approach with respect to the observed characteristics. The basic logic was that each treated firm was matched with "control" firms, which were otherwise similar to the treated firm in terms of the propensity for being treated. A matching method can reduce the bias between two groups and allow for more accurate comparisons of innovation trends between the pre- and post-regulation periods. This approach enabled us to make stronger causal claims about the effect of MSER on firm innovation.

The PSM approach is based on the conditional probability of assignment to a particular treatment given a vector of observed covariates [44]. We adopted a probit regression to determine whether or not a particular firm was "treated" (included in the regulation list). Specifically, we included the firm size, return on equity, share turnover, stock returns, state ownership, and R&D intensity as the determinants that have been closely linked with the entry of regulation lists [3,4]. We selected the pre-regulation period as the matching window. Thus, all the covariates included in the probit regression were averages over the pre-regulation period (2006–2008). Additionally, we incorporated the growth measure of innovation (*patent growth*), which is measured by the growth ratio of the number of a firm's patents over the pre-regulation period, to ensure that the parallel trends assumption was satisfied. We then used the one-to-two nearest-neighbor matching algorithm with replacements to identify the control units. To ensure that the matching procedures improved the balance, we compared the differences in the means between the treatment and control firms (before and after matched) for these covariates. As shown in Table A2, the results revealed that the PSM procedures effectively reduced the differences between our treatment and control firms before the regulations. This procedure resulted in a matching sample of 2958 firm-year observations, 1589 of which were treatment firm years and 1369 of which were control firm years. Table A1 presents the distribution of the matched sample firms across the industry. We found that most observations in our sample came from the manufacturing industry, accounting for 54%, which is similar to the actual distribution of Chinese public firms.

4. Results

4.1. Summary Statistics

Table 2 reports the descriptive statistics of the matched sample firms for the variables used in our main regression and the corresponding correlation matrix. The first two rows contain the main dependent variables, i.e., LnPatents and LnInventions. The average number of patents (the raw value) was 16.02 before matching versus 29.39 after matching; the average number of invention patents was 7.30 before matching versus 14.19 after matching. The average number of invention patents (after matching) was smaller than the average number of utility patents (14.19 vs. 15.19), thus suggesting that applications for invention patents were harder to attain than utility patents [27]. As the correlation matrix shows, firms with higher ROA, lower leverage, and more cash holdings were more likely to invest in R&D; firms with a larger size, older age, and higher leverage had higher innovation outputs, that is, a higher number of patents.

4.2. Main Results

We report the regression results of Equation (1) in Table 3. Columns 1–2 show the regression results for the innovation outputs—*LnPatents* and *LnInventions*—respectively. The coefficient of the interaction term, $Treated \times Post$, is positive and statistically significant in column 1, suggesting the positive impact of MSER on firms' patent counts. In other words, the treatment firms that were required to disclose social and environmental governance information experienced a striking increase in patents relative to the control firms. The economic effect was also sizeable, that is, the number of patents for the treatment firms increased by 19.7% three years after the regulations. Column 2 shows a positive and significant coefficient and suggests that the number of invention patents increased by 16.6% for the treatment firms compared to the control firms. To mitigate concerns regarding potentially omitted variables, we also performed an alternative specification that included the firm and year fixed effects in our DID estimation. The inclusion of firm fixed effects can rule out the interpretation from time-invariant firm characteristics; year fixed effects can absorb common shocks into all firms in a given year. Columns 3 and 4 in Table 3 indicate that our inferences remained unchanged with this alternative specification.

Table 2. Descriptive Statistics and Correlation Matrix (after Matching).

		Mean	S.D.	Min	Max	1	2	3	4	5	6	7
1	LnPatents	1.476	1.652	0.000	8.277	1						
2	LnInventions	0.945	1.313	0.000	8.211	**0.903**	1					
3	Firm size	22.272	1.109	19.272	24.813	**0.264**	**0.260**	1				
4	Firm age	2.659	0.279	1.386	3.258	**0.053**	0.022	**0.069**	1			
5	ROA	0.051	0.051	−0.179	0.197	0.010	**0.045**	−0.012	**−0.106**	1		
6	Leverage	0.511	0.178	0.040	0.870	**0.089**	**0.054**	**0.356**	**0.077**	**−0.439**	1	
7	Cash holdings	0.150	0.107	0.005	0.766	0.030	**0.050**	**−0.120**	**−0.132**	**0.314**	**−0.313**	1
8	R&D intensity	0.004	0.009	0.000	0.058	**0.348**	**0.359**	−0.025	−0.030	**0.132**	**−0.078**	**0.117**

N = 2958. The bold correlation coefficient represents $p < 0.05$.

We further assessed the dynamics of the treatment effect. To do so, we used 2008 as the benchmark year, *Year* (0), and replaced *Post* with five year dummies: *Year* (−2) and *Year* (−1) for the two years prior to the regulations; *Year* (1), *Year* (2), and *Year* (3) for the first, second, and third years after the regulations, respectively. We then made these year dummies interact with *Treated* to capture the dynamic impact of the regulations on firm innovation. As shown in Table 4, the coefficients of all pre-regulation dummies (i.e., $Treated \times Year\ (-2)$ and $Treated \times Year\ (-1)$) were small and insignificant. This evidence reassured us that this matched sample had no pre-existing trend. Thus, the parallel trends were stratified. Moreover, we found that the effect became significant only two years after the regulations, thus suggesting that the MSER took 24 months to translate to higher innovative output, which is consistent with the innovation lag found in previous studies [11,37]. Overall, our main results revealed that MSER in China had a significant effect on firm innovation output. Specifically, the innovation quantity (i.e., total patents) and innovation quality (i.e., the number of invention patents) experienced a striking increase for the treatment firms.

Table 3. The Impact of MSER on Firm Innovation.

	LnPatents (1)	**LnInventions (2)**	**LnPatents (3)**	**LnInventions (4)**
Treated × *Post*	0.197 ***	0.166 ***	0.214 ***	0.176 ***
	(0.072)	(0.060)	(0.069)	(0.058)
Treated	0.330 ***	0.235 ***		
	(0.094)	(0.077)		
Post	0.183 ***	0.324 ***		
	(0.063)	(0.055)		
Firm size	0.398 ***	0.356 ***	0.130 *	0.156 **
	(0.058)	(0.051)	(0.078)	(0.071)
Firm age	0.417 **	0.187	1.137 **	1.234 **
	(0.181)	(0.159)	(0.573)	(0.529)
ROA	−0.248	0.038	0.337	0.312
	(0.802)	(0.723)	(0.493)	(0.417)

Table 3. *Cont.*

	LnPatents (1)	LnInventions (2)	LnPatents (3)	LnInventions (4)
Leverage	−0.142	−0.131	0.159	−0.140
	(0.288)	(0.237)	(0.231)	(0.219)
Cash holdings	−0.025	−0.019	0.184	0.115
	(0.367)	(0.323)	(0.257)	(0.217)
R&D intensity	29.520 ***	27.919 ***	6.222 **	5.218 *
	(5.654)	(6.078)	(2.970)	(3.049)
Constant	−8.836 ***	−7.712 ***	−4.643 ***	−5.828 ***
	(1.254)	(1.107)	(2.082)	(2.004)
Industry fixed effects	Yes	Yes	Yes	Yes
Firm, year fixed effects	No	No	Yes	Yes
Observations	2958	2958	2958	2958
Adjusted R^2	0.496	0.415	0.822	0.804

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 4. The Dynamic Effects of MSER on Firm Innovation.

	LnPatents (1)	LnInventions (2)
Treated	0.353 ***	0.253 ***
	(0.103)	(0.089)
Treated × *Year* (−2)	−0.083	−0.028
	(0.083)	(0.070)
Treated × *Year* (−1)	0.010	−0.026
	(0.074)	(0.061)
Treated × *Year* (0)	(*Omitted*)	
Treated × *Year* (1)	0.113	0.076
	(0.077)	(0.066)
Treated × *Year* (2)	0.219 **	0.183 ***
	(0.087)	(0.070)
Treated × *Year* (3)	0.194 **	0.189 **
	(0.097)	(0.082)
Controls	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	2958	2958
Adjusted R^2	0.498	0.416

Note. The results of the year dummies are omitted for conciseness. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

4.3. Robustness Checks

Nonpatenting Firms. Our regression sample contained firms that did not file patents throughout the sample period, which accounted for 18.7% of all observations. Therefore, our results may have been affected by these nonpatenting firms. Although the inclusion of firm fixed effects in previous analyses has helped to mitigate this concern, we re-estimated our regression after excluding the nonpatenting firms. The results were unchanged (see columns 1–2 in Table 5).

Alternative Observation Windows. In our main analyses, we adopted a three-year observation window to observe the impact of MSER on innovation. In this part, we extend our observation window to four or five years to verify whether our results were sensitive to the selection of the observation window. As shown in Table 5, our results were robust in the four- and five-year observation windows. Moreover, the coefficient of the interaction term, *Treated* × *Post*, increased with the rise in the observation window. In particular, column 5 indicates that the number of patents for the treatment firms increased by 21.1% five years after the regulations, which was larger than the influence after four years (20.6%, column 3) and three years (19.7%, column 1). Similar to the total patents, the impact on invention patents increased with the extension of the observation window (19.6%, 17.6%, and 16.6% after five, four, and three years of the regulations, respectively). The evidence shows that the influence of the MSER still existed after five years.

Table 5. Robustness Checks I—Changing Observation Window

	Excluding Nonpatenting Firms		Four Years after the Regulations		Five Years after the Regulations	
	LnPatents (1)	**LnInventions (2)**	**LnPatents (3)**	**LnInventions (4)**	**LnPatents (5)**	**LnInventions (6)**
Treated × Post	0.152 *	0.141 **	0.206 ***	0.176 ***	0.211 ***	0.196 ***
	(0.083)	(0.071)	(0.074)	(0.062)	(0.075)	(0.065)
Treated	0.349 ***	0.274 ***	0.272 ***	0.187 **	0.256 ***	0.172 **
	(0.114)	(0.096)	(0.098)	(0.081)	(0.098)	(0.081)
Post	0.305 ***	0.129 *	0.172 ***	0.042	0.178 **	0.039
	(0.077)	(0.069)	(0.065)	(0.058)	(0.068)	(0.060)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2406	2406	3345	3345	3821	3821
Adjusted R^2	0.439	0.375	0.523	0.445	0.541	0.469

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Alternative Matching Rules. In our main regression, we used the PSM approach with a combination of one-to-two nearest-neighbor matching and replacement. Here, we selected different matching rules to check the robustness of our findings. Table 6 presents the corresponding results. First, we adopted different nearest-neighbor algorithms, i.e., one-to-one nearest-neighbor matching and nearest-three-neighbors matching, to generate the matched sample. Columns 1–4 indicate that the impact of MSER on the total number of patents and invention patents was unchanged. Second, we set a caliper of 0.02 to the one-to-two nearest neighbor because the *propensity score* between the matched pair may have been too far even if we used the "nearest neighbor". Common practice is to set the caliper to a 0.25* standard error of the propensity score. However, the difference in the propensity scores of all matched pairs in our sample was smaller than a 0.25* standard error of the propensity score (0.07) using default one-to-two nearest-neighbor matching. Therefore, we selected 0.02, a smaller and more restrictive rule, as the size of the caliper. As shown in columns 5 and 6, our results were robust to this setting.

Table 6. Robustness Checks II—Alternative Matching Rules.

	One-to-One Matching		Nearest Three Neighbors		Matching within Caliper	
	LnPatents (1)	**LnInventions (2)**	**LnPatents (3)**	**LnInventions (4)**	**LnPatents (5)**	**LnInventions (6)**
Treated × Post	0.173 **	0.138 **	0.178 **	0.146 **	0.195 ***	0.162 ***
	(0.080)	(0.066)	(0.070)	(0.059)	(0.073)	(0.061)
Treated	0.353 ***	0.258 ***	0.322 ***	0.239 ***	0.320 ***	0.230 ***
	(0.107)	(0.089)	(0.088)	(0.073)	(0.094)	(0.078)
Post	0.216 ***	0.100	0.217 ***	0.092 *	0.189 ***	0.063
	(0.074)	(0.065)	(0.059)	(0.052)	(0.064)	(0.056)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2477	2477	3318	3318	2910	2910
Adjusted R^2	0.488	0.415	0.492	0.416	0.494	0.414

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Placebo Test. Here, we conducted a placebo test by replicating our analysis using a fabricated shock [45]. We set 2007 as the time when the false "MSER" occurred. To avoid "contamination" due to real treatment effects, we only used observations from 2006 to 2008 and supplemented the data on these observations from 2005 to construct balanced before-and-after observation windows. Thus, in this placebo test, our pre-regulation period ranged from 2005 to 2006, and the post-regulation period ranged from 2007 to 2008. This test can help us to rule out alternative explanations caused by unobservable factors. As shown in Table 7, the estimates for *Treated* × *Post* were all attenuated to zero and both coefficients were insignificant, thus suggesting that our main findings were not attributable to any unidentified factors.

Table 7. Robustness Checks III—Placebo Test (2005–2008).

	LnPatens **(1)**	**LnInventions** **(2)**
Treated × *Post*	0.040	0.040
	(0.070)	(0.056)
Treated	0.265 ***	0.188 **
	(0.092)	(0.074)
Post	0.145 **	0.102 *
	(0.067)	(0.057)
Controls	Yes	Yes
Industry fixed effects	Yes	Yes
Observations	1861	1861
Adjusted R^2	0.385	0.310

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

5. Mechanisms

The above estimates indicate that MSER were associated with an increase in firm innovation output, i.e., the number of patents and invention patents. In this section, we explore the underlying mechanisms behind this association. Three potential channels can explain why MSER influenced firm innovation activities: the CSR-improving effect, information-disclosing effect, and market-reaction effect. Below, we discuss each channel in detail and conduct estimates to verify them.

5.1. CSR-Improving Effect

First, we explored whether the CSR-improving effect was dominant in the impact of MSER on firm innovation. An extensive body of literature has investigated the impact of CSR on corporate innovation, and most studies showed that CSR performance could facilitate firm innovation output [11,20]. For example, ref. [20] analyzed panel data collected from firms in the S&P 500 and revealed that the improvement in corporate social performance was able to prompt firm innovation. Ref. [11] found that stakeholder orientation that increased firms' CSR performance sparked innovation by encouraging experimentation (i.e., more tolerance of employees' failures) and enhancing employees' innovative productivity. In addition, ref. [12] demonstrated that firms with higher CSR performance (e.g., better employee treatment schemes) produced more and better patents by improving employee satisfaction and teamwork. Accordingly, the increase in innovation for the treatment firms after the MSER were implemented may have been caused by the improvement in CSR performance.

To test this conjecture, we collected the CSR performance data from the Environmental, Social, and Governance (ESG) database of Bloomberg. The ESG dataset of Bloomberg offers ESG metrics and disclosure scores for more than 11,800 firms in over 100 countries. The ESG data are compiled based on company-sourced filings, such as CSR or sustainability reports, annual reports, company websites, online news, and a Bloomberg survey that requests information directly from the company. We used the rating scores of firms in the Bloomberg ESG database to measure the firms' CSR performance. If this conjecture is valid, the CSR performance of the treatment firms should show a significant increase after the regulations compared with the control firms. The results are reported in Table 8. As shown in column 1 in Table 8, the coefficient of the interaction term *Treated* × *Post* was positive and statistically significant. This indicates that the CSR performance of the treatment firms increased significantly, thus supporting the *CSR-improving effect*. Therefore, the impact of MSER on firm innovation was partially derived from the improvement in CSR performance.

Table 8. Mechanism Analyses.

	CSR Performance (1)	**Forecast Error (2)**	**Institutional Ownership (3)**
Treated × *Post*	4.180 ***	0.003	−0.054 ***
	(0.453)	(0.003)	(0.018)
Treated	3.586 ***	−0.002	0.074 ***
	(0.421)	(0.003)	(0.014)
Post	1.272 ***	−0.014 ***	0.181 ***
	(0.436)	(0.003)	(0.014)
Controls	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Observations	1538	2246	2940
Adjusted R^2	0.475	0.177	0.374

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

5.2. Information-Disclosing Effect

Second, we explored whether the MSER affected innovation through the information-disclosing effect by examining the decrease in information asymmetry. Information asymmetry usually indicates an unpredictable, complex, and volatile transaction environment, which increases transaction costs and hinders firms' innovation activities [15,21]. Thus, the reduction in information asymmetry may prompt innovation. Previous studies have also demonstrated similar results. For example, ref. [14] found that transparency (i.e., low information asymmetry) directly boosted innovation by reducing the sensitivity of management turnover to poor innovative output, and ref. [13] revealed that the more transparent the information environment, the higher the rate of R&D and patenting. At the same time, non-financial reporting for the treatment firms after the MSER were implemented, supplementary to normal financial reports, may have reduced the information asymmetry between the internal managers and outside stakeholders [22,46], thereby improving innovation outputs. To test this conjecture, we followed [22] by using the analyst forecast accuracy (*forecast error*) to measure the firms' information asymmetry. We used the analyst forecast error as an inverse measure of the forecast accuracy, which is defined as the average of the absolute errors of all forecasts made in the year for the target earnings scaled by the stock price at the beginning of the year. If the treatment firms' information asymmetry decreases, we should observe a significant decline in the forecast errors for these firms. Column 2 in Table 8 presents an insignificant coefficient for the analyst forecast accuracy. This observation indicates that the information asymmetry of the treatment firms did not increase after the regulations. Thus, we find the evidence to be inconsistent with this mechanism.

5.3. Market-Reaction Effect

Last, we explored the mechanism of the market-reaction effect. MSER might be a negative sign for investors who argue that treatment firms invest more in social and environmental governance at the expense of shareholders' benefits. Ref. [41] examined the market reaction to events associated with the passage of a directive in Europe mandating increased non-financial disclosure that was related to firms' ESG performance. They found a negative market reaction to events that increased the likelihood of the passage of these regulations. Similarly, ref. [2] investigated the mandatory CSR policy in India using the event study method, as well as a regression discontinuity design, and found that this policy caused a 4.1% drop on average in the stock prices of the affected firms. In China, ref. [3] also revealed that the MSER led to negative effects on firms' ROA and ROE. Consequently, the MSER were interpreted as a negative sign for outside investors.

Institutional investors who pursue short-term benefits may argue that these types of regulations will drive affected firms to pay increased attention to social and environmental issues at the expense of shareholders' benefits [6,47,48]. Therefore, they reduce the stock ownership of firms subject to the MSER. However, a reduction in institutional ownership may encourage firm innovation by eliminating the short-term earning pressures on managers [16–19,49]. Accordingly, the increase in innovation for the treatment firms after the MSER were implemented may have been caused by the reduction in institutional ownership. Institutional ownership is the percentage of outstanding shares held by institutional investors, data on which were collected from the Chinese Research Data Services (CNRDS) database. If the innovation increase for the treatment firms was caused by this, we expected to observe a significant decline in institutional ownership for the treatment firms. As shown in column 3 in Table 8, the coefficients of the interaction term, $Treated \times Post$, were negative and significant, thus supporting the *market-reaction effect*.

Furthermore, institutional investors are usually classified into two types: transient institutional investors and dedicated institutional investors [17,47–49]. Dedicated institutional investors, such as pension funds, insurance companies, and banks, are institutions that have long-term holdings, are less constrained by liquidity needs, and are more willing to use longer periods to evaluate managers' performance [49]. In contrast, transient institutional investors are institutions that chase short-term price appreciation. Thus, they take small equity positions in many firms and tend to trade frequently [49]. Therefore, we suspect that the reduction in institutional ownership (column 3 in Table 8) stemmed mainly from the transient institutional investors. To test this expectation, we investigated the effects of the MSER on the changes in specific institutional investors. Table A4 reports the results. We found that the ownership of dedicated institutional investors (e.g., insurance companies in column 3 and social security funds in column 4) did not experience a striking decline after the regulations. In contrast, the ownership of normal funds that were smaller and more likely to chase short-term profits had a significant decrease after the regulations (see column 1). Additionally, the ownership of securities companies sightly declined (see column 2). The results in column 5 also reveal that qualified foreign institutional investors (QFII) did not change their investment strategies for the treatment firms, thus suggesting foreign investors in China were more likely to chase long-term profits.

In summary, we considered three potential mechanisms and demonstrated that the positive impact of the MSER in China on firm innovation was mainly due to the CSR-improving effect and market-reaction effect.

6. Discussion

An increasing number of countries and regions are paying attention to social and environmental issues and have enacted related laws and policies to cope with them. Previous studies have examined the equity market reaction to these mandatory social and environmental policies [2,41] and the impact of these policies on firm financial performance [3–5], whereas there is little knowledge of how these policies have affected firm innovation activities. On the one hand, some argue that MSER could reduce firm innovation because they could stifle investment in corporate innovation activities. On the other hand, some argue that MSER could facilitate firm innovation due to the benefits from the improvement in CSR performance or report disclosure.

Using the implementation of MSER that occurred in China, we empirically found that the treatment firms' innovation outputs significantly increased after the announcement of the MSER. We further analyzed the possible mechanisms and found that the CSR-improving effect and market-reaction effect played an important role in driving this relationship.

These findings contribute to the literature on the determinants of innovation [50], especially research that investigates the impact of various types of legislation on innovation [11,25,27,28,33–35,37]. In this study, we complemented this line of research by examining the effect of MSER on firm innovation. Our study documented the influencing mechanisms of social and environmental policies on innovation (i.e., the improvement in CSR performance and reduction in institutional ownership). It is helpful to understand the impact of mandatory social and environmental regulations. Additionally, our study contributes to the literature that investigates the impact of CSR and innovation. The endogenous issues related to this relationship have prevented prior researchers from making efficient causal inferences [20,51]. In this study, we addressed this challenge by leveraging an exogenous shock on firms' CSR practices and utilizing a difference-in-differences approach to estimate the relationship between CSR and innovation.

Our findings also have potentially important implications for managers and policymakers. Our findings demonstrate that the net effect of MSER on innovation was positive. In other words, CSR performance and innovation performance were not completely paradoxical. Accordingly, with the increasing CSR pressure nowadays, companies that are eager to innovate may find it worthwhile to improve social and environmental governance. For policymakers, our findings provide an unexpected result, that is, MSER have led to an increase in innovation. Understanding the impact of MSER on firms' other operating activities (e.g., innovation) and their underlying mechanisms allows legislators to comprehensively master the effectiveness of their enacted policies, which is able to assist with the formulation of future policy. This study finds that the CSR-improving effect plays a major role in influencing firm innovation. Thus, the government, for example, can publish policies that require companies to improve employee welfare or can set a higher environmental standard to prompt companies to improve their production technologies.

7. Conclusions

In this study, we answered two research questions: (1) How do mandatory social and environmental regulations influence corporate innovation? and (2) What are the underlying mechanisms that drive this relationship? We exploited an exogenous shock in China in 2008 to examine the impact of MSER on innovation. Using a difference-in-differences with propensity-score matching methodology, we found that MSER in China led to a significant increase in firm innovation. In particular, we found that firms that were mandated to disclose social and environmental information generated more patents, including invention patents that were more innovative and original, than the control firms, which were not required to adhere to these rules after three years of the regulations. Lastly, we verified that the positive effects of the MSER on firm innovation were mainly caused by the CSR-improving effect and market-reaction effect, manifesting in an improvement in CSR performance and a reduction in institutional ownership, respectively.

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Abbreviations

The following abbreviations are used in this manuscript:

MSER	mandatory social and environmental regulations
DID	difference-in-differences
PSM	propensity-score matching
CSR	corporate social responsibility
SSE	Shanghai Stock Exchange
SZSE	Shenzhen Stock Exchange

Appendix A

Table A1. Industry Distribution of Matched Sample.

	Total	Treatment	Control
Agriculture, Forestry, and Fishing (A)	66 (2%)	18 (1%)	48 (4%)
Mining (B)	118 (4%)	65 (4%)	53 (4%)
Manufacturing (C)	1604 (54%)	873 (55%)	731 (53%)
Utilities (D)	222 (8%)	108 (7%)	114 (8%)
Construction (E)	59 (2%)	41 (3%)	18 (1%)
Transportation (F)	201 (7%)	125 (8%)	76 (6%)
Information Technology (G)	144 (5%)	78 (5%)	66 (5%)
Wholesale and Retail (H)	149 (5%)	66 (4%)	83 (6%)
Real Estate (J)	228 (8%)	120 (8%)	108 (8%)
Services (K)	41 (1%)	23 (1%)	18 (1%)
Entertainment (L)	36 (1%)	12 (1%)	24 (2%)
Conglomerates (M)	90 (3%)	60 (4%)	30 (2%)
Total	2958 (100%)	1589 (100%)	1369 (100%)

Table A2. Propensity-Score Matching (PSM) Results.

	Full Sample			Matched Sample			
	Treatment	Control	Difference in Means (before)	Treatment	Control	Difference in Means (after)	Bias Reduction (%)
Firm size	22.264	21.157	1.107 ***	22.264	22.270	−0.006	99.5
ROE	0.119	0.032	0.087 ***	0.119	0.125	−0.006	93.2
Share turnover	3.195	3.649	−0.454 ***	3.195	3.049	0.145	68.0
Stacks return	0.895	0.598	0.297 ***	0.895	0.878	0.016	94.5
State ownership	0.310	0.237	0.073 ***	0.310	0.315	−0.005	92.5
R&D intensity	0.002	0.003	0.000	0.002	0.003	0.000	45.7
Patent growth	1.328	0.485	0.843 ***	1.328	1.390	−0.062	92.6

Note. All covariates in the above table are averages over the pre-regulation period (2006–2008), except for *patent growth*. Patent growth is measured by the growth ratio of the number of a firm's patents over the pre-regulation period, that is, (a firm's patents in 2008–the firm's patents in 2006)/the firm's patents in 2006. Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A3. Definitions of All Variables Used in This Study.

Variables	Definition
Lnpatent	The natural logarithm of one plus the number of invention and utility patents that the firm has filed.
Lnvention	The natural logarithm of one plus the number of invention patents that the firm has filed.
Treated	A dummy variable that is equal to one for treatment firms and zero for control firms.
Post	A dummy variable that equals one if a firm year belongs to the post-regulation period (2009–2011) and zero if a firm year belongs to the pre-regulation period (2006–2008).

Table A3. *Cont.*

Variables	Definition
Firm size	The natural logarithm of total assets.
Firm age	The natural logarithm of the number of years since the firm's inception.
ROA	The ratio of net income to total assets.
ROE	The ratio of net income to shareholders' equity.
Leverage	Total liabilities divided by total assets.
Cash holdings	The ratio of cash to total assets.
R&D Intensity	The ratio of R&D expenses to total assets.
Share turnover	The total number of shares traded divided by the total number of shares outstanding.
Stacks return	Annual stock return of each year.
State ownership	The number of state-owned shares divided by the number of total shares.
Patents growth	The growth ratio of the number of a firm's patents over the pre-regulation period (2006–2008).
Innovative productivity.	The number of patents per 100 employees.
Forecast error	The average of the absolute errors of all forecasts made in the year for target earnings, scaled by the stock price at the beginning of the year.
Voluntary disclosure	A dummy variable that is equal to one if a firm voluntarily discloses social and environmental governance information and zero if otherwise.
Institution ownership	The percentage of outstanding shares held by institutional investors.
Normal Funds	The percentage of outstanding shares held by normal funds.
Securities company	The percentage of outstanding shares held by securities companies.
Insurance company	The percentage of outstanding shares held by insurance companies.
Social security funds	The percentage of outstanding shares held by social security funds.
QFII	The percentage of outstanding shares held by Qualified Foreign Institutional Investors (QFII).

Table A4. The Types of Institutional Investors.

	Normal Funds	Securities Company	Insurance Company	Social Security Funds	QFII
	(1)	(2)	(3)	(4)	(5)
Treated × *Post*	−0.062 ***	−0.001 *	−0.000	−0.001	−0.001
	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)
Treated	0.079 ***	0.001 *	0.000	0.001	0.001
	(0.012)	(0.000)	(0.001)	(0.001)	(0.001)
Post	−0.030 ***	0.001 **	0.000	−0.002 *	−0.002 **
	(0.009)	(0.000)	(0.001)	(0.001)	(0.001)
Controls	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	2958	2958	2958	2958	2958
Adjusted R^2	0.353	0.036	0.050	0.027	0.035

Note. This table reports the estimated coefficients and heteroskedasticity-adjusted robust standard errors clustered at the firm level (in parentheses). Significance at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

References

1. European Commission. Corporate Sustainability Reporting. Available online: https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en (accessed on 18 November 2022).
2. Manchiraju, H.; Rajgopal, S. Does corporate social responsibility (CSR) create shareholder value? Evidence from the Indian Companies Act 2013. *J. Account. Res.* **2017**, *55*, 1257–1300. [CrossRef]
3. Chen, Y.C.; Hung, M.; Wang, Y. The effect of mandatory CSR disclosure on firm profitability and social externalities: Evidence from China. *J. Account. Econ.* **2018**, *65*, 169–190. [CrossRef]
4. Lu, T.; Sivaramakrishnan, K.; Wang, Y.; Yu, L. The real effects of mandatory corporate social responsibility reporting in China. *Prod. Oper. Manag.* **2021**, *30*, 1493–1516. [CrossRef]
5. Ioannou, I.; Serafeim, G. The consequences of mandatory corporate sustainability reporting. In *Harvard Business School Research Working Paper*; Harvard Business School: Boston, MA, USA, 2017.
6. Porter, M.E. Capital disadvantage: America's failing capital investment system. *Harv. Bus. Rev.* **1992**, *70*, 65–82.
7. Chang, X.; Fu, K.; Low, A.; Zhang, W. Non-executive employee stock options and corporate innovation. *J. Financ. Econ.* **2015**, *115*, 168–188. [CrossRef]

8. Murray, A. Corporate R&D Spending Is at a Record High—With Chinese Firms Posting the Fastest Growth. Available online: https://fortune.com/2018/11/01/corporate-rd-spending-2018-china (accessed on 18 November 2022).
9. OECD. *OECD Innovation Strategy 2015 an Agenda for Policy Action*; OECD: Paris, France, 2015.
10. Meramveliotakis, G.; Manioudis, M. Sustainable Development, COVID-19 and Small Business in Greece: Small Is Not Beautiful. *Adm. Sci.* **2021**, *11*, 90. [CrossRef]
11. Flammer, C.; Kacperczyk, A. The impact of stakeholder orientation on innovation: Evidence from a natural experiment. *Manag. Sci.* **2016**, *62*, 1982–2001. [CrossRef]
12. Chen, C.; Chen, Y.; Hsu, P.H.; Podolski, E.J. Be nice to your innovators: Employee treatment and corporate innovation performance. *J. Corp. Financ.* **2016**, *39*, 78–98. [CrossRef]
13. Brown, J.R.; Martinsson, G. Does transparency stifle or facilitate innovation? *Manag. Sci.* **2019**, *65*, 1600–1623. [CrossRef]
14. Zhong, R.I. Transparency and firm innovation. *J. Account. Econ.* **2018**, *66*, 67–93. [CrossRef]
15. Hsieh, C.T.; Huang, H.C.; Lee, W.L. Using transaction cost economics to explain open innovation in start-ups. *Manag. Decis.* **2016**, *54*, 2133–2156. [CrossRef]
16. He, J.J.; Tian, X. The dark side of analyst coverage: The case of innovation. *J. Financ. Econ.* **2013**, *109*, 856–878. [CrossRef]
17. Fang, V.W.; Tian, X.; Tice, S. Does stock liquidity enhance or impede firm innovation? *J. Financ.* **2014**, *69*, 2085–2125. [CrossRef]
18. Qi, J. *The Threat of Shareholder Intervention and Firm Innovation*; Technical Report, Working Paper; University of Minnesota: Minneapolis, MN, USA, 2015.
19. Yang, H. *Institutional Dual Holdings and Risk Shifting: Evidence from Corporate Innovation*; Working Paper; University of Massachusetts Amherst: Amherst, MA, USA, 2019.
20. Wagner, M. Corporate social performance and innovation with high social benefits: A quantitative analysis. *J. Bus. Ethics* **2010**, *94*, 581–594. [CrossRef]
21. Suematsu, C. Innovation and Transaction Cost. In *Transaction Cost Management*; Springer: Berlin/Heidelberg, Germany, 2014; pp. 255–262.
22. Dhaliwal, D.S.; Radhakrishnan, S.; Tsang, A.; Yang, Y.G. Nonfinancial disclosure and analyst forecast accuracy: International evidence on corporate social responsibility disclosure. *Account. Rev.* **2012**, *87*, 723–759. [CrossRef]
23. Hong, M.; Drakeford, B.; Zhang, K. The impact of mandatory CSR disclosure on green innovation: Evidence from China. *Green Financ.* **2020**, *2*, 302–322. [CrossRef]
24. Mbanyele, W.; Huang, H.; Li, Y.; Muchenje, L.T.; Wang, F. Corporate social responsibility and green innovation: Evidence from mandatory CSR disclosure laws. *Econ. Lett.* **2022**, *212*, 110322. [CrossRef]
25. Lerner, J. The empirical impact of intellectual property rights on innovation: Puzzles and clues. *Am. Econ. Rev.* **2009**, *99*, 343–348. [CrossRef]
26. Williams, H.L. Intellectual property rights and innovation: Evidence from the human genome. *J. Polit. Econ.* **2013**, *121*, 1–27. [CrossRef] [PubMed]
27. Fang, L.H.; Lerner, J.; Wu, C. Intellectual property rights protection, ownership, and innovation: Evidence from China. *Rev. Financ. Stud.* **2017**, *30*, 2446–2477. [CrossRef]
28. Acharya, V.V.; Subramanian, K.V. Bankruptcy codes and innovation. *Rev. Financ. Stud.* **2009**, *22*, 4949–4988. [CrossRef]
29. Cerqueiro, G.; Hegde, D.; Penas, M.F.; Seamans, R.C. Debtor rights, credit supply, and innovation. *Manag. Sci.* **2017**, *63*, 3311–3327. [CrossRef]
30. Lin, C.; Liu, S.; Manso, G. Shareholder litigation and corporate innovation. *Manag. Sci.* **2021**, *67*, 3346–3367. [CrossRef]
31. Brown, J.R.; Martinsson, G.; Petersen, B.C. Law, stock markets, and innovation. *J. Financ.* **2013**, *68*, 1517–1549. [CrossRef]
32. Levine, R.; Lin, C.; Wei, L. Insider trading and innovation. *J. Law Econ.* **2017**, *60*, 749–800. [CrossRef]
33. Zheng, Y.; Wang, Q. Shadow of the great firewall: The impact of Google blockade on innovation in China. *Strateg. Manag. J.* **2020**, *41*, 2234–2260. [CrossRef]
34. Zhu, J.; Fan, Y.; Deng, X.; Xue, L. Low-carbon innovation induced by emissions trading in China. *Nat. Commun.* **2019**, *10*, 1–8. [CrossRef]
35. Kwon, S.; Marco, A.C. Can antitrust law enforcement spur innovation? Antitrust regulation of patent consolidation and its impact on follow-on innovations. *Res. Policy* **2021**, *50*, 104295. [CrossRef]
36. He, J.; Tian, X. Finance and corporate innovation: A survey. *Asia-Pac. J. Financ. Stud.* **2018**, *47*, 165–212. [CrossRef]
37. Acharya, V.V.; Baghai, R.P.; Subramanian, K.V. Wrongful discharge laws and innovation. *Rev. Financ. Stud.* **2014**, *27*, 301–346. [CrossRef]
38. Gao, H.; Hsu, P.H.; Li, K.; Zhang, J. The real effect of smoking bans: Evidence from corporate innovation. *J. Financ. Quant. Anal.* **2020**, *55*, 387–427. [CrossRef]
39. Orens, R.; Aerts, W.; Cormier, D. Web-based non-financial disclosure and cost of finance. *J. Bus. Financ. Account.* **2010**, *37*, 1057–1093. [CrossRef]
40. Dhaliwal, D.S.; Li, O.Z.; Tsang, A.; Yang, Y.G. Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *Account. Rev.* **2011**, *86*, 59–100. [CrossRef]
41. Grewal, J.; Riedl, E.J.; Serafeim, G. Market reaction to mandatory nonfinancial disclosure. *Manag. Sci.* **2019**, *65*, 3061–3084. [CrossRef]

42. Kumar, N.; Qiu, L.; Kumar, S. Exit, voice, and response on digital platforms: An empirical investigation of online management response strategies. *Inf. Syst. Res.* **2018**, *29*, 849–870. [CrossRef]
43. Zhou, K.Z.; Gao, G.Y.; Zhao, H. State ownership and firm innovation in China: An integrated view of institutional and efficiency logics. *Adm. Sci. Q.* **2017**, *62*, 375–404. [CrossRef]
44. Rosenbaum, P.R.; Rubin, D.B. The central role of the propensity score in observational studies for causal effects. *Biometrika* **1983**, *70*, 41–55. [CrossRef]
45. Bertrand, M.; Duflo, E.; Mullainathan, S. How much should we trust differences-in-differences estimates? *Q. J. Econ.* **2004**, *119*, 249–275. [CrossRef]
46. Lys, T.; Naughton, J.P.; Wang, C. Signaling through corporate accountability reporting. *J. Account. Econ.* **2015**, *60*, 56–72. [CrossRef]
47. Bushee, B.J. Do institutional investors prefer near-term earnings over long-run value? *Contemp. Account. Res.* **2001**, *18*, 207–246. [CrossRef]
48. Zhang, Y.; Gimeno, J. Earnings pressure and long-term corporate governance: Can long-term-oriented investors and managers reduce the quarterly earnings obsession? *Organ. Sci.* **2016**, *27*, 354–372. [CrossRef]
49. Bushee, B.J. The influence of institutional investors on myopic R&D investment behavior. *Account. Rev.* **1998**, 305–333.
50. Manso, G. Motivating innovation. *J. Financ.* **2011**, *66*, 1823–1860. [CrossRef]
51. Shen, R.; Tang, Y.; Zhang, Y. *Does Firm Innovation Affect Corporate Social Responsibility?*; Working Paper; Harvard Business School: Paris, France, 2016.