Analyst forecast quality and corporate social responsibility: the mediation effect of corporate governance

Yuan George Shan and Joey Wenling Yang
Department of Accounting and Finance, UWA Business School, The University of Western Australia, Perth, Australia

Junru Zhang
School of Business and Law, Edith Cowan University, Perth, Australia, and

Millicent Chang
School of Accounting, Economics and Finance, University of Wollongong, Wollongong, Australia

Received 21 February 2021
Revised 17 July 2021
8 November 2021
16 December 2021
Accepted 4 January 2022

Abstract

Purpose – This study aims to examine the mediating role played by corporate governance (CG) in the relationship between corporate social responsibility (CSR) and analyst forecast quality.

Design/methodology/approach – The authors raise three specific questions: Does CG play a mediating role in the relationship between CSR and analyst forecast quality? If so, is such mediation effect of CG reduced for firms with weak governance? Do firms with superior CSR performance experience higher analyst forecast quality through the mediation effect of CG?

Findings – The present results suggest that CG serves as a partial mediator that facilitates CSR's positive influence on analyst forecast quality. However, further analyses show that in firms with a low governance score, CG does not have a mediation effect. Conversely, the authors find that firms with superior CSR performance have higher forecast quality through the mediation effect of CG. The authors also find that the mediation effect of CG is more pronounced for the environmental component than for the social component of CSR.

Originality/value – To the best of the authors' knowledge, this study is the first to investigate the role of CG as a mediator between CSR and analyst forecast quality and to reveal that the strength of this effect varies depending on firms' CG level and CSR commitment.

Keywords Corporate governance (CG), Corporate social responsibility (CSR), Quantitative research, Mediation effect, Analyst forecast quality, Analyst earning forecast error, Analyst forecast dispersion

Paper type Research paper

JEL Classification – G34, M14, M41

Conflict of interest: The authors declare no conflict of interest.

The authors are grateful to the Associate Editor Professor Nathan Joseph of *Meditari Accountancy Research* and anonymous reviewers for their constructive comments and suggestions on earlier versions of this paper. We also acknowledge the constructive comments on earlier versions of this paper received from seminar participants at School of Accounting, Economics, and Finance, Curtin University.

Meditari Accountancy Research

2049-372X
DOI 10.1108/MEDAR-02-2021-1200

1. Introduction

Informative stock price in financial markets is essential to efficient resource allocation in an economy, and the analyst report is an important avenue to producing a more informed stock price that also leads to better stock performance in the long term (Brav and Lehavy, 2003; Fernandez *et al.*, 2011; Asquith *et al.*, 2005; Lennox and Park, 2006). Although corporate social responsibility (CSR) is becoming a significant part of corporate activity, the literature about the influence of CSR on analyst forecast quality offers largely mixed findings. Some studies find that socially responsible firms experience lower levels of conflict among stakeholders, which may reduce information asymmetry in prices and thus result in more accurate analyst forecasts (Al-Hadi *et al.*, 2019; Becchetti *et al.*, 2015). Other studies suggest that CSR can be used by management as a greenwashing strategy to manipulate legitimacy for obtaining societal acceptance (Jo and Harjoto, 2012; Orlitzky, 2013), which can lead to price distortion and potentially mislead analyst forecasts. In an attempt to reconcile these inconclusive findings, we incorporate the unique role of corporate governance (CG) as a mediator, aiming to investigate the mediation effect of firms' CG on the relationship between CSR and analyst forecast quality.

The consideration of CG is built on past findings that CG increases the likelihood of firms engaging actively in CSR (Jo and Harjoto, 2012; Oh *et al.*, 2011; Rezaee, 2009) and simultaneously authenticating firm-specific information through mechanisms such as monitoring, which results in improved price informativeness (Gul *et al.*, 2011; Ferreira and Laux, 2007; Byard *et al.*, 2006). We focus on analyst forecast quality because it is one of the important mechanisms to help reduce information asymmetry in stock price and to improve price informativeness (Chan and Hameed, 2006). We examine the first two research questions: whether CG plays a mediating role that complements CSR in improving analyst forecast quality, and if it does, whether this mediation effect is weaker for firms with weaker governance.

Further, Lys *et al.* (2015) argue that because CSR practices are often viewed as a direct indicator of strong financial performance, CSR activities undertaken by firms with strong financial performance can often signal firms' financial prospects through their engagement in additional CSR activities at a level that is above the industry average – excess CSR. Moreover, past studies also find that CSR can be used by some firms as a greenwashing strategy to meet legitimacy requirements and that excess CSR is simply viewed as self-serving and self-promoting activities that have no economic effect (Lee *et al.*, 2013; Lyon and Maxwell, 2011). To shed light on this debate, our third research question following the above two is to examine whether excess CSR performance affects analyst forecast quality through CG as a mediator.

We use a dataset consisting of 8,426 firm-year observations from 2006 to 2018 on US firms. We find that CG partially mediates the nexus between CSR and analyst forecast quality, whereby CSR can increase analyst forecast quality directly, as well as through the indirect effect of CG as a mediator on analyst forecast quality. We also show that this mediating role of CG is muted for firms with weak governance. We then find that excess CSR performance strongly improves analyst forecast quality through the partial mediating role of CG. In additional analyses, we separate firms' CSR performance into environmental and social components and show that the mediation effect of CG is more pronounced for environmental information than it is for social information.

Our study makes several incremental contributions to the literature. From the theoretical aspect, we reconcile the mixed results regarding the effect of CSR on analyst information quality by establishing the mediating role of CG between CSR and analyst forecast quality. Although studies have examined the role of CSR and CG in improving information asymmetry, our evidence shows a specific partial mediation of CG in CSR's effect on analyst forecast quality [1]. Our method to test the mediation effect, proposed by Baron and Kenny (1986) and the Sobel

test (see Figure 1), is similar to that used by Wang and Sarkis (2017), but their focus is on CSR and firm performance. Further, the finding on the mediating role of CG in this study lends support to the contention that CG and CSR complement each other in the market to improve analyst forecast quality which leads to lower information asymmetry and price efficiency. That is, our evidence supports that CG complements CSR to enhance analyst forecast quality through a partial mediation effect (Oh *et al.*, 2018).

From the practical perspective, this study offers empirical evidence that enhances the understanding of the signaling hypothesis that excess CSR engagement enhances analyst forecast quality through CG as a mediator. In addition, we provide evidence on the information asymmetry effects of individual CSR components (environmental and social). In support of the view that different components of CSR activities influence stakeholders in different ways (Boubakri *et al.*, 2019; Lu and Abeysekera, 2017; Rezaee, 2009), we show that the mediation effect of CG is more pronounced for environmental CSR than for social CSR.

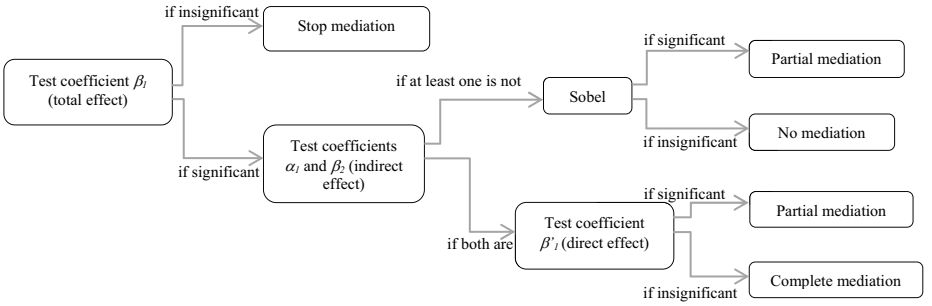
The remainder of the paper is organized as follows. Section 2 reviews prior literature and develops the hypotheses. Section 3 explains the data sources, defines the variables and specifies the methods used. Section 4 provides the descriptive statistics and presents the empirical results. Section 5 conducts additional analyses. Section 6 concludes the paper.

2. Literature and hypotheses development

2.1 Mediation effect of corporate governance on the relationship between corporate social responsibility and analyst forecast quality

The reaction of capital markets to analysts' equity reports specifically pinpoints the usefulness of sell-side analyst forecasts. Brav and Lehavy (2003) contend that the targeted prices from analyst forecasts provide market participants with analysts' most concise, explicit statements on the magnitude of a firm's expected value. Fernandez *et al.* (2011) indicate that analysts often compute the target prices in their forecasts as the product of forecasted earnings and base these prices on critical financial ratios, such as earnings yield. Asquith *et al.* (2005) suggest that target prices are informative in the presence of earnings forecasts, and their findings support the argument that market participants only consider price formation from multiple sources of forecasts to be useful. Lennox and Park (2006) posit that earnings forecasts are effective in reducing information asymmetry because they contain news that is more informative about the firm value than do other information channels.

The most widely adopted definition of CSR follows that of McWilliams and Siegel (2001), who also examine excess corporate accountability and responsibility that supersede legal



Source: Wu *et al.* (2020)

Figure 1.
Mediation effect test flow

requirements. According to legitimacy theory, a company must meet the expectations of the community in which it operates to ensure it can obtain resources for its long-term survival. During the legitimation process, managers must constantly seek information about community expectations and inform the community about their CSR activities to fulfil their embedded social contract (Deegan, 2014). The literature demonstrates that firms engaging in CSR have higher information transparency through reporting to their stakeholders (Jo and Na, 2012). Conversely, because CSR reporting is voluntary and CSR ratings can be biased, some firms may also use CSR as a window-dressing strategy to manipulate corporate legitimacy. This conflict may cause investors to have an unclear view about the firm's engagement in CSR activities. Supporting this view are Jo and Harjoto (2012) and Orlitzky (2013), who show that announcements of CSR activity are viewed as a management strategy to manipulate legitimacy, which introduces bubbles and noise into stock prices. Financial analysts are outsiders with less access to firm-specific information than corporate insiders such as CEOs and managers. Therefore, financial analysts provide an important service by providing additional information to investors (Piotroski and Roulstone, 2004). We conjecture that the different incentives of CSR activity may reduce information asymmetry to firm-specific information, which affects the quality of analyst forecasts.

Conversely, CG is documented to play an active role in firms' engagement in legitimate CSR. Jo and Harjoto (2012) show a positive causal effect of CG on firms' CSR that leads to higher firm performance. Rezaee (2009) contends that CG should be viewed as a dynamic and integrated approach to addressing financial, social, environmental and economic concerns of all stakeholders. CG is also shown to improve analyst forecast quality. For example, Gul *et al.* (2011) argue that CG improves the quality of public disclosure through better monitoring and oversight roles. Byard *et al.* (2006) reveal that the quality of information used by analysts improves with the quality of firms' CG. Combining these two roles played by CG that promote firms' CSR and analyst forecast quality, we argue that CG may act as a mediator in the relationship between CSR and analyst forecast quality. Specifically, we posit that, given the considerable extent of price distortion in a semi-strong efficient market, different incentives and implications of CSR may influence information asymmetry in the market that obscures disclosure transparency (Jo and Na, 2012). Firms with strong CG can offer a high level of monitoring, which consequently lowers the extent of information asymmetry, thereby increasing information accessibility and credibility for analysts to produce higher-quality reports. Thus, we propose CG as a mediator in the relationship between CSR and the analyst forecast quality [2]:

H1. CG mediates the relationship between CSR and analyst forecast quality.

Because CG and CSR activities involve a considerable amount of resource allocation, extensive CSR activity may potentially hinder firms' CG investment. Low levels of CG could weaken its influence on enhancing the quality of analysts' information about the firm's future performance (Byard *et al.*, 2006), in turn reducing the power of its mediating effect in the nexus of CSR and analyst forecast quality. We formally test this in the following sub-hypothesis:

H1a. CG's mediation effect is weaker or muted for firms with low levels of CG.

2.2 Excess corporate social responsibility and mediation

Lys *et al.* (2015) argue that engaging in CSR practices is believed to be a direct result of strong financial performance, whereby firms are found to undertake CSR activities in a

period when they anticipate stronger future financial performance. The authors therefore suggest that CSR undertaken by firms who expect strong future performance will produce signaling information about the firm's prospects through excess CSR performance. However, the challenges lie in how to resolve the trade-offs between the benefits of excess CSR and the costs associated with stakeholder communications. As stakeholders may be aware of the possibility of window-dressing strategies adopted by some firms, excess CSR is often suspected to be self-serving, which attracts critical stakeholder attention and risks firms being caught in the self-promoter's paradox (Lee *et al.*, 2013). Lyon and Maxwell (2011) suggest that managers tend to hesitate to encourage excess CSR engagement because activists view many CSR activities as greenwashing.

Considering the mixed signals conveyed by excess CSR, we posit that excess CSR can influence analyst forecast quality via CG. For instance, excess CSR requires firms to inform the market about their financial prospects, but firms may deliberately not convey such information to the market (Lys *et al.*, 2015) [3]. Thus, excess CSR may signal potential strong future financial performance, but it may also cause auxiliary distortion in the market, which can potentially become misleading information. However, strong CG adds credibility to the firm, which mitigates the likelihood of its excess CSR being interpreted as greenwashing by external stakeholders. Thus, we propose CG as a mediator between excess CSR and analyst forecast quality through the following hypothesis:

H2. CG mediates the relationship between excess CSR and analyst forecast quality.

3. Data and methods

3.1 Data and sample

This study includes all firms listed on the New York Stock Exchange and the NASDAQ over the financial years between 2009 and 2018 [4]. The financial data are sourced from Thomson Reuters DataStream. The variables are at firm-year intervals. The data for financial analysts' forecast dispersion and earnings forecast error are collected from the I/B/E/S database. The CSR and CG variables are sourced from Sustainalytics, which contains the scores for CSR in relation to environmental and social responsibility, and CG based on firm-level data. The initial sample includes 75,921 observations. After removing firms with missing financial data (47,326) and missing analyst data (20,169), the final number of observations used in the study is 8,426, among which 2,833 had been given CSR scores by Sustainalytics.

3.2 Variables measurement

The key variables are measured as follows. In line with the literature, analyst forecast quality is measured using analyst forecast dispersion (Lee and Liu, 2011; Pástor and Pietro, 2003) and analyst earnings forecast errors (Becchetti *et al.*, 2015; Behn *et al.*, 2008). For CSR measures, the total CSR score, and the scores of its two constituents – environmental and social sustainability – from Sustainalytics are adopted [5]. The definitions of the key variables are presented in Appendix 1.

A considerable body of research suggests that analyst forecast quality is measured by analyst forecast dispersion (Balkanska, 2018; Felo *et al.*, 2018; Lee and Liu, 2011) and analyst earning forecast error (Becchetti *et al.*, 2015; Beekes and Brown, 2006; Behn *et al.*, 2008). We follow past literature to measure forecast quality using both analyst forecast dispersion and analyst earnings forecast errors.

3.2.1 Analyst forecast dispersion: F_DISP. Analyst forecast dispersion measures the divergence of expertise expectation based on existing publicly available information and partially known private information. High analyst forecast quality is associated with a low level of forecast dispersion and low earnings forecast errors (Lee and Liu, 2011). Following prior studies (Balkanska, 2018; Felo *et al.*, 2018; Lee and Liu, 2011), we use analyst forecast dispersion as our first proxy for forecast quality. Thus, we follow Lee and Liu (2011) and use analyst forecast dispersion (F_DISP), calculating it as the standard deviation of earnings per share (EPS) scaled by the absolute mean forecast EPS for each reporting quarter. Then, we average the quarterly dispersion over the year for firm-year $F\_DISP_{i,t}$:

$$F\_DISP_{i,t} = \frac{1}{Q_{i,t}} \sum_{q=1}^{Q_{i,t}} \frac{SD\_Forecast\_EPS_{i,q}}{|Mean\_Forecast\_EPS_{i.q}|}$$

where $SD\_Forecast\_EPS_{i,q}$ is the standard deviation forecast EPS for firm i in quarter q; $Mean\_Forecast\_EPS_{i,q}$ is the forecast EPS mean for firm i in quarter q; and $Q_{i,t}$ is the number of quarters for which data are available for firm i in year t.

3.2.2 Analysts earning forecast error: ERR. When forecast quality is higher because of information transparency, analysts' forecasted earnings are less likely to contain errors (Becchetti *et al.*, 2015; Behn *et al.*, 2008). We use analyst earning forecast error as the second proxy of analyst forecast quality. The forecast error is calculated as the absolute value of the difference between the average earning forecast for the next fiscal year and the actual EPS, scaled by the stock price in that month. The calculation for average forecast error during year t is as follows:

$$F\_ERR_{i,t} = \frac{1}{M_{i,t}} \sum_{m=1}^{M_{i,t}} |Mean\_Forecast\_EPS_{i.m} - EPS_{i,m}|$$

where $Mean\_Forecast\_EPS_{i,m}$ is the mean of the forecast EPS for firm i in month m; and $M_{i,t}$ is the number of months for which data are available for firm i in year t. The following transformation is then made (Lee and Liu, 2011) [6]:

$$ERR_{i,t} = \log\left(0.0001 + F\_ERR_{i,t}\right)$$

where $ERR_{i,t}$ is the transformed forecast error for firm i at year t; and $F\_ERR_{i,t}$ is the raw forecast error for firm i at year t.

3.2.3 Corporate social responsibility and corporate governance variables. Following the method of Hillman and Keim (2001) and Surroca *et al.* (2010), we adopt the CSR and CG ratings to measure firm-level CSR. We use data from Sustainalytics because it comprehensively captures CSR performance at firm level, which addresses aggregation concerns when using the Kinder, Lydenberg, and Domini (KLD) CSR rating [7]. In addition, the Sustainalytics CSR measures address the aggregation issues identified by Graafland *et al.* (2004) and Rowley and Berman (2000) in three way. First, the individual dimensions of KLD CSR are sometimes uncorrelated and are not representable to the latent variable. Sustainalytics includes a multinational appraisal and captures the factor-level representability in its methodology (Surroca *et al.*, 2010). Second, stakeholders have various expectations about CSR across industries; Sustainalytics adopts a sector-specific weighted

approach in its scoring methodology. Third, the treatment of ordinal measures of CSR in KLD CSR is as though they were cardinal (Surroca *et al.*, 2010), Sustainalytics instead uses independent expert opinions to weigh all relevant CSR dimensions of companies.

3.2.4 Control variables. We include the following firm-specific control variables used in the literature: firm size (SIZE), measured as the natural logarithm of a firm's market capitalization for the fiscal year-end (Dasgupta *et al.*, 2010; Gul *et al.*, 2011; Hutton *et al.*, 2009; Kim and Shi, 2012); market-to-book ratio (MB), measured as market capitalization scaled by the book value of equity for the fiscal year-end (Crawford *et al.*, 2012; Dasgupta *et al.*, 2010; Piotroski and Roulstone, 2004); leverage ratio (LEV), measured as the firm's total long-term debt divided by its total assets (Dasgupta *et al.*, 2010; Hutton *et al.*, 2009; Kim and Shi, 2012); profitability (ROA), measured as income before extraordinary items divided by total assets (Dasgupta *et al.*, 2010; Gul *et al.*, 2011; Piotroski and Roulstone, 2004); volatility of profitability (V_ROA), measured as the standard deviation of the ROA ratio in the previous five years (Crawford *et al.*, 2012; Gul *et al.*, 2011; Piotroski and Roulstone, 2004); and analysts following (N_ANA), measured as the number of analysts following the firm in that fiscal year (Kim and Shi, 2012). In addition, we include two industry-specific variables: industry size (IND_SIZE), measured as natural logarithm of the number of firms in the industry to which firm i belongs (Piotroski and Roulstone, 2004); and industry competition (IND_COMP), measured as the sum of the squared terms of the proportion of a firm's revenue to total revenue in the industry to which firm i belongs (Piotroski and Roulstone, 2004). The variable definitions are presented in Appendix 1.

3.3 Research design

3.3.1 Propensity score matching. The extant literature demonstrates that empirical models with CSR variables can suffer from endogeneity, leading to mixed findings (Cheung, 2016; Kim *et al.*, 2014; Wu and Shen, 2013). In our study, it is possible that our results are driven by other firm-level characteristics common to firms selected by the Sustainalytics database. To address this concern, we follow past studies to adopt the propensity score matching (PSM) approach [8]. Specifically, we construct a benchmark sample to match each firm that has been given a score by Sustainalytics. We follow the literature to use a probit model to estimate the probability of a firm being rated by Sustainalytics with the following sets of variables in our regression: firm size (total assets), performance (return on equity), leverage (debt-to-asset ratio), industry classification and firm age (years of each observation). For industry classification, we follow Dhaliwal *et al.* (2011) to define CSR-sensitive industries with the US SIC codes 2833–2836, 3570–3577, 3600–3674, 5200–5961 and 7370. To further justify this, Panel A of Appendix 2 presents the likelihood of CSR significantly and positively associated with firm size, performance, leverage, industry and age. Panel B of Appendix 2 presents the effectiveness of PSM.

3.3.2 Model for mediation effect. Following Gul *et al.* (2011) and Lee and Liu (2011), we estimate the baseline model to test the total effect of CG. In equation (1a), we test the total effect of CSR on the analyst forecast quality after controlling for firm characteristics. In equation (1b), we test the total effect of CSR on analyst forecast quality after controlling for CG. We also control for firm-, year- and industry-fixed effects, and cluster robust standard errors by firm in all analyses. We trim all continuous variables at the first and 99th percentiles to reduce the likelihood of outlying observations influencing the estimations:

$$FQ_{i,t} = \rho_1 + \rho_2 CSR_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (1a)$$

$$FQ_{i,t} = \rho_1 + \rho_2 CSR_{i,t} + \rho_3 CG_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (1b)$$

where $FQ_{i,t}$ represents analyst forecast quality for firm i at time t, which is either analyst forecast dispersion $F\_DISP_{i,t}$ or analyst forecast error $ERR_{i,t}$; CSR is the CSR score; and CG is the CG score.

We then adopt the basic four-step Baron and Kenny approach as described by Baron and Kenny (1986) and Kenny *et al.* (1998) to examine the mediation effect of CG in the relationship between CSR and analyst forecast quality (as stated in *H1*) by using the following model specifications:

$$FQ_{i,t} = \beta_0 + \beta_1 CSR_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (2a)$$

$$CG_{i,t} = a_0 + a_1 CSR_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (2b)$$

$$FQ_{i,t} = \beta_0' + \beta_1' CSR_{i,t} + \beta_2 CG_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (2c)$$

The procedure of the mediation test is presented in Figure 1. Equation (2a) examines the overall effect of CSR on analyst forecast quality, which is denoted by β_1. The effect of CSR on CG is captured as a_1 in equation (2b). In equation (2c), β_1' denotes the direct effect from CSR to analyst forecast quality mediated by CG, and β_2 denotes the indirect effect of CSR on analyst forecast quality through the mediator – CG. Based on the definition of a mediator by Baron and Kenny (1986), CG can be considered a mediator when the following four conditions are met: CSR is correlated with analyst forecast quality and estimates that there is an effect that may be mediated ($\beta_1 \neq 0$); CSR is correlated with CG, which shows the mediator as though it were an outcome variable ($a_1 \neq 0$); CG is shown to affect analyst forecast quality while controlling for CSR ($\beta_2 \neq 0$) – CSR must be controlled for because CG and analyst forecast quality are both directly caused by CSR; to formulate a complete meditation effect, the effect of CSR on analyst forecast quality controlling for CG (β_1') should be zero ($\beta_1' = 0$). If all these conditions are met, the mediation effect is consistent with the hypothesis that CG completely mediates the relationship between CSR and analyst forecast quality. However, if the fourth condition is not satisfied, partial mediation is indicated [9]. Baron and Kenny (1986) state that trivially small coefficients can be statistically significant with large sample sizes and very large coefficients can be insignificant with samples. While statistical significance is informative, other information should be part of statistical decision-making. Therefore, in this study, we follow Baron and Kenny (1986), Kenny *et al.* (1998) and Wang and Sarkis (2017) by also considering the estimated coefficients.

To test *H1*, we examine the mediation effect of CG on the relationship between CSR and analyst forecast quality. We first test the total effect of CSR on analyst forecast quality (β_1)

and proceed only when β_1 is significant. We then test the indirect effect of CSR on analyst forecast quality mediated by CG. If the indirect effect (a_1 and β_2) and the direct effect ($\beta_1^{'}$) are significant, it will suggest the effect of CSR on analyst forecast quality is mediated by a nontrivial amount with the inclusion of CG, thereby showing partial mediation (Preacher and Hayes, 2004). However, if the direct effect ($\beta_1^{'}$) becomes insignificant while having significant a_1 and β_2, it will suggest that CG has a complete mediation effect on the relationship between CSR and analyst forecast quality. If at least a_1 and β_2 are not significant, we further conduct the Sobel test. The null hypothesis for the Sobel test indicates the indirect effect of CG on CSR and analyst forecast quality ($a_1 \times \beta_2$) is zero (or equivalent, $\beta_1 - \beta_1^{'} = 0$) [10]. The rejection of a null hypothesis in the Sobel test indicates a partial mediation effect.

To test *H1a*, we partition our sample of firms according to their firm-level CG scores, with the bottom 33% CG scores. We then examine the total effect of the CSR–F_DISP relationship and the CSR–ERR relationship using equations (1a) and (1b). Finally, we examine the effect of the mediation through CG on the relationship between CSR and analyst forecast quality among the subsample of firms underperforming in CG using equations (2a)–(2c).

To test *H2*, we examine the effect of excess CSR on analyst forecast quality through the mediation of CG. In particular, we develop an excess CSR proxy to examine its effect on analyst forecast quality, as well as through the mediation of CG. The extant literature suggests that the effect of institutional isomorphism on CSR is driven by industry-wide factors, which may increase CSR performance (Beddewela and Fairbrass, 2016; Matten and Moon, 2008). To distinguish whether CSR is an industry norm or signal, we follow Lys *et al.* (2015) by distinguishing between two levels of CSR: CSR engagement that is in line with the industry CSR median (represented by the average of the CSR score in an industry), which is referred to in this study as "optimal CSR"; CSR engagement that is greater than the industry CSR median (represented by the average of the CSR score in an industry), which is referred to in this study as "excess CSR." We then substitute excess CSR into equations (1a) and (1b) to examine the total effect as follows:

$$F\_DISP_{i,t} = a_1 + a_2 CSR\_exs_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \tag{3a}$$

$$F\_DISP_{i,t} = a_1 + a_2 CSR\_exs_{i,t} + a_3 CG_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \tag{3b}$$

After adjusting equations (2a)–(2c), we have the following equations to examine the mediation effect. For firms that have CSR below industry median, $CSR\_exs_{i,t}$ takes the value of zero.

$$F\_DISP_{i,t} = \beta_0 + \beta_1 CSR\_exs_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \tag{3c}$$

$$CG_{i,t} = a_0 + a_1 CSR\_exs_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \tag{3d}$$

$$F\_DISP_{i,t} = \beta_0' + \beta_1' CSR\_exs_{i,t} + \beta_2 CG_{i,t} + \sum_i Controls_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (3e)$$

where $F\_DISP_{i,t}$ is analyst forecast dispersions; $CSR\_exs_{i,t}$ is excess CSR measured by the difference between firm-level CSR and the industry CSR median.

4. Results

4.1 Descriptive statistics

Table 1 presents the distribution of variables in the sample and shows the proportion per industry in the full sample and the PSM sample datasets. We determine industry using the Fama–French 12-industry classification with four-digit SIC codes. The proportion of the CSR (treatment) firms is relatively higher in the business equipment, manufacturing, retail and finance industries [11]. This trend is similar to that for the benchmark firms in the full sample; however, the health-care industry occupies a considerable proportion of the composition in our benchmark, which contradicts the proportion of composition of the treatment samples.

Table 2 provides the descriptive statistics for the key variables based on the PSM sample. F_DISP shows that the mean F_DISP (ERR) during the sample period is 0.12 (0.04) for the treatment firms and 0.15 (0.04) for the benchmark firms. In the treatment CSR group, the mean CSR value is 104.31, which is slightly higher than its median value of 102, whereas the mean and the median for CG are 64.38 and 65, respectively. N_ANA is considerably

	Full sample						PSM sample					
	Total		Treat		Bench		Total		Treat		Matched	
Industry	*N*	(%)	*N*	(%)	*N*	%	*N*	(%)	*N*	(%)	*N*	(%)
Nondurables	393	4.66	175	6.18	218	3.9	283	4.99	175	6.18	108	3.81
Durables	251	2.98	81	2.86	170	3.04	170	3	81	2.86	89	3.14
Manufacturing	986	11.7	377	13.31	609	10.89	662	11.67	377	13.31	285	10.06
Energy	323	3.83	160	5.65	163	2.91	254	4.48	160	5.65	94	3.32
Chemicals	269	3.19	127	4.48	142	2.54	207	3.65	127	4.48	80	2.82
Business equipment	1,384	16.43	495	17.47	889	15.89	825	14.56	495	17.47	330	11.65
Telecom	175	2.08	66	2.33	109	1.95	128	2.26	66	2.33	62	2.19
Utilities	207	2.46	112	3.95	95	1.7	191	3.37	112	3.95	79	2.79
Shops	884	10.49	342	12.07	542	9.69	667	11.77	342	12.07	325	11.47
Health care	1,113	13.21	237	8.37	876	15.66	406	7.17	237	8.37	169	5.97
Finance	1,171	13.9	304	10.73	867	15.5	1,036	18.28	304	10.73	732	25.84
Others	1,270	15.07	357	12.6	913	16.32	837	14.77	357	12.6	480	16.94
Total	8,426	100	2,833	100	5,593	100	5,666	100	2,833	100	2,833	100

Notes: This table presents the proportion per industry based in the full sample and the PSM sample data sets. We use Fama-French 12 industry classification with four-digit SIC code to identify industries. Specially, nondurables include food, tobacco, textiles, apparel, leather and toys; durables include cars, TV, furniture and house appliances; manufacturing includes machinery, trucks, planes, papers, printing; energy includes oil, gas and coal extraction and products; chemicals include chemicals and allied products; business equipment includes computers, software and electronic equipment; telecom includes telephone and television transmission; shops include wholesale, retail, laundries and repair shops; health care includes health and medical equipment and drugs; others include the rest of industries, such as mining, construction, building, transport, hotels, business services and entertainment

Table 1.
Distribution of treatment and benchmark firms by industry sector

higher for the treatment CSR group than for the benchmark group, which indicates that CSR firms have a greater propensity to receive attention from analysts. The remainder of the variables show similar patterns among the two groups.

4.2 Baseline regression on corporate social responsibility and the analyst forecast quality

To investigate the total effect of CSR on analyst forecast quality, we estimate equations (1a) and (1b). Table 3 presents the estimation results. Columns 1–4 show that CSR and CG have no effect on forecast dispersion (F_DISP) or forecast error. The results from the PSM-matched samples in Columns 5–8 are similar. This finding supports the argument of Orlitzky (2013) and Orlitzky *et al.* (2011) that firms may use CSR as a window-dressing strategy, which could lead to heterogeneous outcomes in prices among market participants and exacerbate information asymmetry.

We then examine the mediating role of CG in the relationship between CSR and analyst forecast quality by estimating equations (2a)–(2c) simultaneously. The results are presented in Panel A (full sample) and Panel B (PSM sample) of Table 4. The overall effect of CSR on analyst forecast quality is shown in Column 1, while Column 3 identifies the mediation effect of CG. The coefficients of CSR are negative in Columns 1 and 3 of Panel A of Table 4. While the magnitude of the coefficients of CSR is at about the same level in Columns 1 and 3, the significance level is higher in Column 1 ($\beta_1 = -0.0016$, $t = -10.65$, $p < 0.01$) compared with Column 3 ($\beta_1^{'} = -0.0016$, $t = -2.19$, $p < 0.05$). A positive impact of CSR on CG ($a_1 = 0.5971$; $t = 441.38$, $p < 0.01$) in Column 2 suggests that firms with good CSR performance are more likely to cause CG. Notably, the estimated coefficient is small for β_2 (however, $\beta_2 \neq 0$). Baron and Kenny (1986) state that high correlations may lead to multicollinearity when the effects of the independent variable and the mediator on the dependent variable are estimated. We follow Baron and Kenny (1986) to further examine the coefficients and investigate whether partial mediation effect exists through the Sobel test. We find that the z-value equals 1.0216, which is greater than the critical z-value of 0.97, that is, $|1.0216| > |0.97|$[12]. The statistical interpretations are as follows: one unit increase in CSR causes a decrease of analyst forecast dispersion by 0.16 basis points (Column 1 of Panel A); one unit increase in CSR causes an increase of CG by 0.6% (Column 2 of Panel A); one unit increase in CSR mediated by CG causes a further decrease of analyst forecast dispersion by 0.16 basis

	PSM treat (N = 2,833)					PSM bench (N = 2,833)				
Variable	Mean	SD	P25	Median	P75	Mean	SD	P25	Median	P75
F_DISP	0.12	0.19	0.03	0.05	0.11	0.15	0.21	0.04	0.06	0.14
ERR	0.04	0.05	0.01	0.02	0.04	0.04	0.05	0.01	0.02	0.04
CSR	104.31	17.96	90	102	118	–	–	–	–	–
CG	64.38	7.41	60	65	70	–	–	–	–	–
SIZE	8.96	1.06	8.18	8.95	9.74	7.08	7.09	6.48	7.09	7.65
MB	3.42	2.41	1.60	2.73	4.44	2.38	1.78	1.23	1.79	2.77
LEV	0.25	0.17	0.12	0.24	0.36	0.22	0.19	0.03	0.19	0.35
ROA	0.06	0.05	0.02	0.06	0.09	0.04	0.03	0.01	0.03	0.07
V_ROA	0.04	0.04	0.012	0.02	0.05	0.04	0.02	0.01	0.02	0.07
N_ANA	12.69	5.79	8	13	17	5.65	5	3	5	7
IND_COMP	0.43	0.27	0.20	0.38	0.62	0.25	0.17	0.06	0.17	0.35
IND_SIZE	2.81	1.34	1.79	2.56	3.61	3.23	2.83	2.08	2.83	4.63

Notes: This table presents descriptive statistics of the variables. Variable definition is presented in Appendix 1

Table 2.
Descriptive statistics

Table 3.
Total effect – CSR, corporate governance and analyst forecast quality

Variable	Panel A: Full sample					Panel B: PSM		
	F_DISP		ERR			F_DISP	ERR	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CSR	0.0003 (1.01)	0.0002 (0.13)	0.2592 (0.11)	0.5706 (0.13)	0.0004 (0.36)	0.0006 (0.26)	0.0001 (0.63)	0.0003 (0.43)
CG		0.0002 (0.09)		−0.2872 (−0.06)		−0.0004 (−0.11)		−0.0002 (−0.20)
Controls								
SIZE	−0.0619*** (−7.08)	−0.0977*** (−4.54)	−0.0032 (−0.58)	−0.0679 (−2.05)	−0.0499*** (−6.43)	−0.0499*** (−6.43)	−0.0165*** (−7.66)	−0.0165*** (−7.66)
MB	−0.0002** (−2.08)	−0.0002* (−1.83)	−3.8253 (−0.14)	−5.2928 (−0.20)	−0.0173 (−1.12)	−0.0017 (−1.13)	−0.0037*** (−7.66)	−0.0378*** (−8.78)
LEV	0.3596*** (7.73)	2.7188*** (3.96)	0.0196 (0.01)	−0.0034 (−0.23)	0.1367*** (4.85)	0.1365*** (4.83)	0.0602*** (7.66)	0.0601*** (7.63)
ROA	−0.0064 (−1.38)	−0.0034 (−0.72)	−0.0258 (−0.21)	−0.0233 (−0.20)	−0.9048***	(−13.76)		−0.9045*** (−13.76)
−0.4292*** (−23.43)		−0.4290*** (−23.41)						
V_ROA	0.0052 (0.61)	−0.0030 (−0.03)	−0.0179 (−0.08)	−0.0298 (−0.14)	0.1047*** (11.75)	0.1041*** (11.75)	−0.0397* (−1.61)	−0.0397* (−1.61)
N_ANA	−0.0037 (−1.49)	−0.0045 (−1.03)	0.0014 (1.24)	0.0011 (1.23)	−0.0002 (−0.18)	−0.0002 (−0.19)	−0.0030 (−0.88)	−0.0030 (−0.97)
IND_COMP	−0.8032*** (−2.95)	−1.0223*** (−4.38)	−0.0003 (−0.50)	−0.0001 (−0.37)	−0.0277 (−0.64)	−0.0277 (−0.64)	−0.0071 (−0.59)	−0.0072 (−0.61)
IND_SIZE	0.0707*** (6.34)	1.0760*** (3.95)	−0.0024 (−0.48)	0.0571 (0.13)	−0.0292*** (−2.72)	−0.0291*** (−2.72)	−0.0932** (−3.13)	−0.0093*** (−3.14)
Intercept	0.7703*** (9.12)	0.7701*** (9.10)	0.0006* (1.77)	0.0006* (1.77)	0.1834*** (5.68)	0.1811*** (5.57)	0.0956*** (11.05)	0.0960*** (11.01)
Firm-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.0111	0.0111	0.0004	0.0005	0.0584	0.0551	0.0221	0.0219
F-statistics	9.08	8.17	2.99	2.70	62.28	56.04	109.24	98.30
N	8,426	8,426	8,426	8,426	5,666	5,666	5,666	5,666

Notes: This table presents the total effect of CSR on analyst forecast quality. The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

Table 4. Mediating effect of corporate governance

	Panel A: Full sample						Panel B: PSM					
Variable	F_DISP (1)	F_DISP CG (2)	F_DISP (3)	ERR (4)	ERR CG (5)	ERR (6)	F_DISP (7)	F_DISP CG (8)	F_DISP (9)	ERR (10)	ERR CG (11)	ERR (12)
CSR	−0.0016***	0.5971***	−0.0016**	−0.0087*	0.5971***	−0.0019*	−0.0003***	0.5909*** (314.29)	−0.0006***	−0.0001**	0.5909***	−0.0001*
	(−10.65)	(441.38)	(−2.19)	(−1.72)	(441.38)	(−0.75)	(−5.74)		(−2.96)	(−2.56)	(314.29)	(−1.70)
CG			0.0002			−0.0021			0.0006			0.0001
			(0.22)			(−0.30)			(1.67)			(0.26)
Sobel test	$\beta_1 = -0.0016$***			$\beta_1 = -0.0087$*			$\beta_1 = -0.0003$*			$\beta_1 = -0.0001$*		
	$\alpha_1 = 0.5971$***, $\beta_2 = 0.0002$			$\alpha_1 = 0.5971$***, $\beta_2 = -0.0021$			$\alpha_1 = 0.5909$***, $\beta_2 = 0.0006$			$\alpha_1 = 0.5909$***, $\beta_2 = 0.0001$		
	$\beta_1' = -0.0016$**			$\beta_1' = -0.0019$*			$\beta_1' = -0.0006$***			$\beta_1' = -0.0001$***		
	Sobel test z-stat = $\lvert 1.0216 \rvert > \lvert 0.97 \rvert$			Sobel test z-stat = $\lvert -1.2676 \rvert > \lvert 0.97 \rvert$			Sobel test z-stat = $\lvert 1.6719 \rvert > \lvert 0.97 \rvert$			Sobel test z-stat = $\lvert 1.1346 \rvert > \lvert 0.97 \rvert$		
Mediation effect	Partial mediation			Partial mediation			Partial mediation			Partial mediation		
N	8,426			8,426			5,666			5,666		

Notes: This table presents the mediation effect of CG in the relationship between CSR and analyst forecast quality by estimating equations (2a)–(2c) simultaneously. The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

points (Column 3 of Panel A). Thus, the significant mediating relationship is confirmed, demonstrating that the partial mediation of CG on CSR and analyst forecast quality is not trivial[13].

The findings are consistent when we investigate the CSR and ERR relationship in the full sample. The explanatory power of CSR on ERR remains negative when the mediation of CG is controlled for in Column 6 of Panel A of Table 4 [14]. We further examine the mediation effect of CG on the CSR and F_DISP relationship and the CSR and ERR relationship with the PSM samples. The results confirm that CG partially mediates the relationship between CSR and analyst forecast quality (see Panel B of Table 4).

In conclusion, our results show that CG partially mediates the relationship between CSR and analyst forecast quality. Thus, *H1* is supported. This is a step forward in explaining the mechanism through which CSR affects analyst forecast quality. For example, if forecast quality cannot be transformed effectively because of agency issues that lead to managers' opaque information disclosure, then strong CG can exert control over managerial misbehavior to reduce principal–agent conflicts and improve the quality of public disclosure through better monitoring (Gul *et al.*, 2011; Jo and Harjoto, 2012). Thus, CG is a mechanism that partially transforms CSR into analyst forecast quality by imposing a greater level of information transparency.

Because the meditation of CG is partial, strong CSR itself may lead to greater analyst forecast quality either directly or through other mediators. That is, the influence of CSR on analyst forecast quality is partial through CG. This finding suggests that the market expects firms with outstanding CG to deliver sound long-term sustainable performance (Gul *et al.*, 2011). Meanwhile, strong CSR signals can communicate directly to the market, leading CSR information to be incorporated into the price-transformation process. This result is consistent with that of Lys *et al.* (2015), who suggest that strong CSR performance is positively associated with future firm performance through a channel in which outsiders may infer insiders' private information about firms' financial prospects.

4.3 Effect of firm-level corporate governance on mediation

In this section, we further investigate the effect of CG in mediating the relationship between CSR and analyst forecast quality. First, we select the firms underperforming in CG from the treatment group (i.e. those that have the lowest 33% CG scores). We then test the total effect of the CSR and F_DISP, and the CSR and ERR relationships using equations (1a) and (1b). Similar to the results from the baseline model, as observed from Columns 1 to 4 of Panel A of Table 5, we find that CSR and CG do not have a significant effect on the analyst forecast quality.

Further, we examine the effect of the mediation through CG on the relationship between CSR and analyst forecast quality among subsample of firms underperforming in CG. The coefficients of CSR are negative in Columns 1 and 3 of Panel B of Table 5, showing that CSR decreases analyst forecast quality among the underperforming CG firms through the total effect. The absolute value of the coefficient of CSR is slightly higher in Column 1 ($\beta_1 = -0.0013$, $t = -3.23$, $p < 0.01$) than in Column 3 ($\beta_1' = -0.0014$, $t = -3.26$, $p < 0.01$), while the significance levels are at about the same level. A significantly positive impact of CSR on CG ($a_1 = 0.0429$; $t = 4.67$, $p < 0.01$) shown in Column 2 suggests that even for underperforming CG firms, CSR performance enhances CG. However, the small and insignificant for β_2 ($\beta_2 = 0.0008$; $t = 0.47$, $p > 0.1$) indicates that CG has no impact on F_DISP. On the basis of Baron and Kenny (1986), we continue examining the mediation effect through the Sobel test, which indicates no mediation effect of CG in the relationship between CSR and analyst forecast quality among the underperforming CG

Table 5. CSR, corporate governance and analyst forecast quality for underperforming CG firms

Variable	F_DISP		ERR	
	(1)	(2)	(3)	(4)
Panel A: Total effect				
CSR	−0.0001	−0.0007	0.0002	0.0007
	(−0.14)	(−1.25)	(0.13)	(0.48)
CG		0.0013		0.0002
		(1.42)		(0.64)
Controls	Yes	Yes	Yes	Yes
Intercept	0.2032***	0.1494**	0.0591***	0.0794***
	(2.89)	(1.97)	(2.63)	(4.1919)
Fixed effects	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry
Adj. R^2	0.2926	0.3374	0.0079	0.1874
F-statistics	5.86	7.91	26.1527	23.72
N	835	835	835	835

Panel B: Mediation effect

Variable	F_DISP			ERR		
	F_DISP	CG	F_DISP	ERR	CG	ERR
	(1)	(2)	(3)	(4)	(5)	(6)
CSR	−0.0013***	0.0429***	−0.0014***	−0.0001	0.0429***	−0.0002
	(−3.23)	(4.67)	(−3.26)	(−1.21)	(4.67)	(−1.38)
CG			0.0008			0.0005
			(0.47)			(1.19)
Sobel test	$\beta_1 = -0.0013$***			$\beta_1 = -0.0001$		
	$\alpha_1 = 0.0429$***, $\beta_2 = 0.0008$			$\alpha_1 = 0.0429$***, $\beta_2 = 0.0005$		
	$\beta'_1 = -0.0014$***			$\beta'_1 = -0.0002$		
	Sobel test *z*-stat = |0.4663| < |0.97|			Sobel test stopped		
	Fail mediation hypothesis					
Mediation effect	No mediation			No mediation		
N	835			835		

Notes: This table presents the results of the nonmonotonic effect of CG in mediating the relationship between CSR and analyst forecast quality. The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; **if $p < 0.05$; ***if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

sample group [15]. We further check our results for the CSR and ERR relationship. However, we find that the direct effect is not significant in the first step; that is, CSR is not significant to ERR. Thus, we stop the mediation test. Overall, our results support *H1a*, suggesting that mediation effect of CG in the relationship of CSR and analyst forecast quality is muted for firms with poor CG.

4.4 Effect of excess corporate social responsibility on mediation

This section examines the effect of excess CSR through the CG mediation effect. To test *H2*, we develop an excess CSR proxy to examine the effect of excess CSR on analyst forecast quality, as well as the mediation effect of CG on this relationship. The results presented in Panel A of Table 6 show that excess CSR does not have a significant effect on analyst forecast dispersion, and they are consistent with the results of the baseline model. We then examine the mediation effect of CG on the relationship between CSR and analyst forecast quality. Shown in Panel B of Table 6, the significant direct as well as the indirect effects of excess CSR on analyst forecast dispersion indicate a partial mediation effect of CG on the relationship between excess CSR and F_DISP. The partial mediation effect is further confirmed by the Sobel test. We find that the *z*-value exceeds the critical value ($|3.5299| > |0.97|$). We interpret the coefficients as follows: an increase of one unit in excess CSR causes a decrease of analyst forecast dispersion by 0.02 basis points (Column 1 of Panel B); an increase of one unit in excess CSR causes an increase of CG by 0.4% (Column 2 of Panel B); and withholding the partially mediation effect from excess CSR → CG, an increase of one unit in excess CSR mediating from CG causes a further decrease of analyst forecast dispersion by 0.01 basis points (Column 3 of Panel B). Hence, our results suggest that excess CSR reduces analyst forecast dispersion partially through CG, and partially through excess CSR performance, and these results confirm our findings in the main analysis, which suggests that *H2* is supported.

5. Additional analyses

After presenting results for our main hypotheses, we now turn to address the measurement concerns about the different components of CSR (i.e. environmental CSR and social CSR), as well as the endogeneity concern.

5.1 Social versus environmental components of corporate social responsibility

Boubakri *et al.* (2019) and Lu and Abeysekera (2017) suggest that various CSR components are perceived and interpreted differently by stakeholders. Given that CSR consists of two major components – environmental and social responsibility – in this section, we test the individual effect of each CSR component on analyst forecast quality. For the total effects, equations (1a) and (1b) are accordingly modified as follows:

$$FQ_{i,t} = a_1 + a_2 EoS_{i,t} + \sum_i Contols_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (4a)$$

$$FQ_{i,t} = a_1 + a_2 EoS_{i,t} + a_3 CG_{i,t} + \sum_i Contols_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (4b)$$

where $EoS_{i,t}$ is a vector that contains $ENV_{i,t}$ and $SO_{i,t}$; ENV is the environmental disclosure score; and SO is the social disclosure score. The following models are used, after adjusting equations (2a)–(2c):

$$FQ_{i,t} = \beta_0 + \beta_1 EoS_{i,t} + \sum_i Contols_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (4c)$$

$$CG_{i,t} = a_0 + a_1 EoS + \sum_i Contols_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (4d)$$

$$FQ_{i,t} = \beta_0^{'} + \beta_1^{'} EoS_{i,t} + \beta_2 CG_{i,t} + \sum_i Contols_{i,t} + Firm\ FE + Year\ FE + Industry\ FE + \varepsilon_{i,t} \quad (4e)$$

As shown in Panel A of Table 7, the results indicate that the environmental and the social components of CSR have an insignificant effect on analyst forecast quality. For ENV and F_DISP in Columns 1–3 of Panel B, the mediation fails the Sobel test. Thus, we reject the mediating effect of CG on ENV and analyst forecast quality. Similar findings are suggested for the relationship between variable SO and analyst forecast quality, including F_DISP and ERR (see Columns 7–12 of Panel B of Table 7), for which we accept the null hypothesis. These results indicate that the market considers environmental and social information jointly, rather than relying on one of either environmental or social information to reveal CSR.

Notably, from Column 6 of Panel B of Table 7, CG shows a partial mediation effect on the relationship between the environmental component of CSR and ERR ($\beta_1^{'} = -0.0002$, $p < 0.1$; Sobel z-stat = 1.0775). This partial mediation shows a direct effect through the path from CSR to analyst forecast quality, and an indirect path from CSR to analyst forecast quality via CG. The reduction in errors in analyst earnings forecasts indicates that environmental disclosures provide better input to increase the accuracy of analysts' forecasts than social disclosures. This result can be interpreted as follows in conjunction with Harjoto and Jo's (2015) finding that the environmental component of CSR may involve a higher level of regulatory scrutiny: in the presence of monitoring, the costs to the market of verifying the credibility of environmental information are reduced, while information accessibility is increased. In contrast, providing information about the social dimension of CSR remains largely voluntary and has a trivial effect on decreasing information asymmetry (Harjoto and Jo, 2015). As we do not directly test the regulatory requirements for environmental versus social CSR disclosures in our sample, the above finding should be interpreted with caution.

5.2 Endogeneity consideration

One challenge in the empirical literature in CSR is the endogeneity bias. While firms with better CSR generate higher analyst forecast quality, it may also be possible that firms with

Table 6.
Excess CSR, corporate governance and analyst forecast dispersion

Variable	F_DISP (1)	F_DISP (2)
Panel A: Total effect		
CSR_exs	0.0001	0.0001
	(1.48)	(1.50)
CG		−0.0007
		(−0.38)
Controls	Yes	Yes
Intercept	0.1741***	0.1853***
	(5.72)	(5.76)
Fixed effects	Firm, year, industry	Firm, year, industry
Adj. R^2	0.0544	0.0545
F-statistics	65.53	56.28
N	5,666	5,666

Panel B: Mediation effect			
Variable	F_DISP (1)	CG (2)	F_DISP (3)
CSR_exs	−0.0002***	0.3977***	−0.0001*
	(−4.11)	(47.42)	(−1.59)
CG			−0.0003***
			(−3.54)
Sobel test		$\beta_1 = -0.0002$***	
		$\alpha_1 = 0.3977$***, $\beta_2 = -0.0003$***	
		$\beta_1' = -0.0001$*	
		Sobel test *z*-stat = |3.5299| > |0.97|	
Mediation effect		Partial mediation	
N		5,666	

Notes: This table reports the results for the effect of excess CSR through the CG mediation. The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; *if $p < 0.10$; ***if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

Table 7. Environmental versus social component of CSR

Variable	Environmental component (ENV) F_DISP (1)	F_DISP (2)	ERR (3)	ERR (4)	Social component (SO) F_DISP (5)	F_DISP (6)	ERR (7)	ERR (8)
Panel A: Total effect								
ENV or SO	0.0002	0.0005	0.0008	0.0002*	−0.0005	−0.0006	0.0002	−0.0001
	(0.82)	(1.16)	(1.30)	(1.77)	(−0.27)	(−1.27)	(0.04)	(−1.00)
CG		−0.0003		−0.0001		0.0005		0.0001
		(−0.87)		(−1.30)		(1.27)		(1.11)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.1835***	0.1818***	0.0963***	0.0970***	0.1814***	0.1799***	0.0946***	0.0945***
	(5.67)	(5.60)	(11.13)	(11.14)	(5.65)	(5.60)	(11.01)	(10.97)
Fixed effects	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry
Adj. R^2	0.0547	0.0547	0.0223	0.0225	0.0549	0.0547	0.0220	0.0221
F-statistics	62.34	56.18	109.41	98.65	62.27	56.21	109.18	98.39
N	5,666	5,666	5,666	5,666	5,666	5,666	5,666	5,666

Panel B: Mediation effect

Variable	Environmental component (ENV) F_DISP		ERR				Social component (SO) F_DISP		ERR			
	F_DISP	CG	F_DISP	ERR	CG	ERR	F_DISP	CG	F_DISP	ERR	CG	ERR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ENV or SO	−0.0006***	1.1685***	−0.0012***	−0.0007***	1.1685***	−0.0002*	−0.0005***	1.1552***	−0.0007*	0.0006**	1.1552***	−0.0001
	(−6.01)	(241.00)	(−4.01)	(−2.67)	(241.00)	(−1.82)	(−5.45)	(310.97)	(−1.73)	(2.47)	(310.97)	(−1.33)
CG			−0.0005*			0.0008			0.0002			0.0007
			(−1.83)			(1.01)			(0.46)			(0.77)
Controls and intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry	Firm, year, industry
Sobel test	$\beta_1 = -0.0006$***			$\beta_1 = -0.0007$***			$\beta_1 = -0.0005$***			$\beta_1 = 0.0006$*		
	$\alpha_1 = 0.1685$***, $\beta_2 = -0.0005$*			$\alpha_1 = 1.1685$***, $\beta_2 = 0.0008$			$\alpha_1 = 1.1552$***, $\beta_2 = 0.002$			$\alpha_1 = 1.1552$***, $\beta_2 = 0.0007$		
	$\beta_1' = -0.00012$***			$\beta_1' = -0.0002$*			$\beta_1' = -0.0007$*			$\beta_1' = -0.0001$		
	Sobel test *z*-stat = |0.7487| < |0.97|			Sobel test *z*-stat = |1.0775| > |0.97|			Sobel test *z*-stat = |0.4639| < |0.97|			Sobel test *z*-stat = |0.7679| < |0.97|	
	Fail mediation hypothesis						Fail mediation hypothesis			Fail mediation hypothesis		
Mediation effect	No mediation			Partial mediation			No mediation			No mediation		
N	5,666			5,666			5,666			5,666		

Notes: This table presents the results for the environmental and the social components of CSR on analyst forecast quality through the CG mediation. The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; *if $p < 0.10$; **if $p < 0.05$; ***if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

better forecast quality engage CSR to a higher extent. To overcome this endogeneity concern, we follow Jo and Harjoto (2012) by using an instrumental variable two-stage least square (IV-2SLS) approach. Our choice of an instrumental variable is the average CSR and CG score aggregated by firm age. According to Jo and Harjoto (2012), firm age is highly corrected with CSR engagement but is uncorrelated with corporate fundamentals; older firms can afford CSR engagement, but they may not necessarily lead to high analyst forecast quality. Thus, we develop age_CSR and age_CG as instrumentals for CSR and CG scores based on firm age. We calculate firm age by taking the difference between firm initial public offering (IPO) year and reporting fiscal year. The three IV-2SLS models we estimate to mitigate the endogeneity of CSR on FQ, CSR on CG and CG on FQ are specified below:

$$\begin{aligned} CSR_{i,t} &= \partial_1 + \partial_2 age\_CSR_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \\ FQ_{i,t} &= \partial_1 + \partial_2 CSR_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \end{aligned} \tag{5a}$$

$$\begin{aligned} CSR_{i,t} &= \partial_1 + \partial_2 age\_CSR_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \\ CG_{i,t} &= \partial_1 + \partial_2 CSR_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \end{aligned} \tag{5b}$$

$$\begin{aligned} CG_{i,t} &= \partial_1 + \partial_2 age\_CG_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \\ FQ_{i,t} &= \partial_1 + \partial_2 CG_{i,t} + \textstyle\sum_i Controls + \varepsilon_{i,t} \end{aligned} \tag{5c}$$

The results are reported in Table 8, in which Columns 1–6 show the results for CSR → CG → F_DISP relationship, Columns 7–12 show the results for CSR→CG→ERR relationship and, overall, we find that our results are consistent with our main analyses. To examine if our instrumentals are legitimate, we report the results for weak instrument, regressor endogeneity and over-identification tests. For weak instrument test, as shown from Cragg–Donald F-stats, we reject the null across all the models and move forward with the assumption that the instrument is sufficiently strong. For regressor endogeneity test, the null hypothesis for Wu–Hausman difference is that all the regressors are exogenous. As seen from Wu–Hausman J-stats across all the columns, we accept the null, suggesting that our instrumental variable and the other controls variables are exogenous. Last, we have Sargan/Hensen test for over-identification restrictions, which examines if more than one instrument per endogenous variables is included because of excess information. The null is that the instruments included are valid. Because our results do not reject the null, over-identification is not a concern. The findings from the IV-2SLS approach suggest that our results are robust and do not suffer from endogeneity.

5.3 Sample excluding financial institutions

We check the robustness of our results further by excluding financial institutions. The rationale for this approach is related to the unique debt structure of these institutions, which makes it possible to increase analyst forecast dispersion, thereby causing undervaluation led by debt-financing announcements by financial institutions (Hadlock and James, 2002). As shown in Table 9, the results are consistent with our main analysis using the full samples, where CSR and CG are insignificant through the total effect models but show partial mediation through the Sobel test. The magnitude and the significance level of the coefficient of CSR are lower in Column 3 Panel B ($\beta_1^{'} = -0.0016$, $t = -2.47$, $p < 0.05$) than in Column 1 ($\beta_1 = -0.0018$, $t = -13.74$, $p < 0.01$). While positive impact of CSR on CG ($a_1 = 0.6003$; $t = 420.09$, $p < 0.01$) in Column 2 is found, the estimated coefficient is small for β_2 (however, $\beta_2 \neq 0$). Likewise, we further show a partial mediation effect exists through

Table 8. Endogeneity check with IV-2SLS approach

	F_DISP						ERR					
	CSR endogeneity using IV Equation (5a)		CSR endogeneity using IV Equation (5b)		CG endogeneity using IV Equation (5c)		CSR endogeneity using IV Equation (5a)		CSR endogeneity using IV Equation (5b)		CG endogeneity using IV Equation (5c)	
	First stage CSR	Second stage F_DISP	First stage CSR	Second stage CG	First stage CG	Second stage F_DISP	First stage CSR	Second stage ERR	First stage CSR	Second stage CG	First stage CG	Second stage ERR
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
age_CSR	0.2833*** (5.92)		0.2833*** (5.92)				0.2833*** (5.92)		0.2833*** (5.92)			
CSR		−0.0101** (−2.32)		0.6305*** (15.16)				−0.0015* (−1.93)		0.6305*** (15.16)		
age_CG					0.3152*** (6.29)						0.3152*** (6.29)	
CG						−0.0146 (−1.30)						0.0039 (1.15)
Controls												
SIZE	12.5648*** (39.68)	0.0363 (0.64)	12.5648*** (39.68)	−0.1931 (−0.37)	7.7237** (38.41)	0.0219 (0.43)	12.5648*** (39.68)	−0.1251*** (−4.23)	12.5648*** (39.68)	−0.1931 (−0.37)	7.7237** (38.41)	−0.1345*** (−4.93)
MB	−0.0041 (−0.75)	−0.0002* (−1.89)	−0.0041 (−0.75)	−0.0002 (−0.19)	−0.0028 (−0.82)	−0.0002** (−2.13)	−0.0041 (−0.75)	−0.0001 (−1.00)	−0.0041 (−0.75)	−0.0002 (−0.19)	−0.0028 (−0.82)	−0.0007 (−0.97)
LEV	10.3253*** (5.97)	0.4616*** (6.92)	10.3253*** (5.97)	0.2979 (0.55)	6.8307*** (6.21)	0.4571*** (6.91)	10.3253*** (5.97)	0.2301*** (5.81)	10.3253*** (5.97)	0.2979 (0.55)	6.8307*** (6.21)	0.2212*** (5.57)
ROA	−0.0996 (−0.75)	−0.0111** (−2.38)	−0.0996 (−0.75)	0.0133 (0.49)	−0.0494 (−0.33)	−0.0108*** (−2.53)	−0.0996 (−0.75)	−0.0113 (−1.31)	−0.0996 (−0.75)	0.0133 (0.49)	−0.0494 (−0.33)	−0.1123 (−1.33)
V_ROA	0.7212* (1.66)	0.0177 (1.20)	0.7212* (1.66)	−0.0466 (−0.99)	0.4081 (1.48)	0.0163 (1.19)	0.7212* (1.66)	0.0098 (0.82)	0.7212* (1.66)	−0.0466 (−0.99)	0.4081 (1.48)	0.0094 (0.81)
N_ANA	2.7533*** (29.76)	0.0313*** (2.59)	2.7533*** (29.76)	−0.2131* (−1.83)	1.5226*** (25.91)	0.0257 (1.20)	2.7533*** (29.76)	0.0090 (1.45)	2.7533*** (29.76)	−0.2131* (−1.83)	1.5226*** (25.91)	0.0077 (1.49)
IND_COMP	1.5176*** (4.35)	0.0016 (0.15)	1.5176*** (4.35)	−0.2047** (−2.27)	0.7579*** (3.42)	−0.0029 (−0.29)	1.5176*** (4.35)	0.0016*** (0.29)	1.5176*** (4.35)	−0.2047** (−2.27)	0.7579*** (3.42)	0.0017 (0.227)
IND_SIZE	−3.6681*** (−4.46)	−0.0058 (−0.279)	−3.6681*** (−4.46)	0.1510 (0.78)	−2.1721*** (−6.96)	−0.0001 (−0.01)	−3.6681*** (−4.46)	0.0039 (0.39)	−3.6681*** (−4.46)	0.1510 (0.78)	−2.1721*** (−6.96)	0.0063 (0.69)
Intercept	−93.94*** (−24.53)	−0.03 (−0.08)	−93.94*** (−24.53)	4.03 (1.12)	−55.75*** (−22.82)	0.11 (0.33)	−93.94*** (−24.53)	0.92*** (4.55)	−93.94*** (−24.53)	4.03 (1.12)	−55.75*** (−22.82)	0.97*** (5.45)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*continued*)

Table 8.

	F_DISP						ERR					
	CSR endogeneity using IV Equation (5a)		CSR endogeneity using IV Equation (5b)		CG endogeneity using IV Equation (5c)		CSR endogeneity using IV Equation (5a)		CSR endogeneity using IV Equation (5b)		CG endogeneity using IV Equation (5c)	
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
Variable	CSR (1)	F_DISP (2)	CSR (3)	CG (4)	CG (5)	F_DISP (6)	CSR (7)	ERR (8)	CSR (9)	CG (10)	CG (11)	ERR (12)
Adj. R^2	0.1783		0.9599		0.1345		0.1767		0.9599		0.1666	
N	8,426		8,426		8,426		8,426		8,426		8,426	
Cragg–Donald												
F-stat	33.49***		33.49***		36.22***		33.49***		33.49***		36.22***	
p-Value	0.00		0.00		0.00		0.00		0.00		0.00	
Wu–Hausman												
J-stats	0.690		0.319		0.814		0.008		0.319		0.285	
p-Value	0.406		0.572		0.367		0.927		0.572		0.594	
Sargan/Hansen test	0.42		0.01		0.12		0.11		0.01		0.01	
p-Value	0.99		0.99		0.99		0.99		0.99		0.99	

Notes: This table reports the results of the instrumental variable two-stage-least square (IV-2SLS) approach. Columns 1 and 2 (or Columns 7 and 8) report the results for IV-2SLS model between CSR and F_DISP (or ERR) based on equation (5a); Columns 3 and 4 (or Columns 9 and 10) report the results for CSR and CG based on equation (5b); and Columns 5 and 6 (or Columns 11 and 12) report the results for CG and F_DISP (or ERR) based on equation (5c). The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; *if $p < 0.10$; **if $p < 0.05$; ***if $p < 0.01$. All tests are two-tailed, and cluster robust standard errors are used in the estimation. Summary statistics of the two instrumental variables are shown below

Variable	Mean	P25	Median	P75	SD	Observations
age_CSR	35.10	28.28	39.80	39.80	7.60	8,426
age_CG	21.67	18.19	24.34	26.34	4.61	8,426

where age_CSR (age_CG) is the average CSR (CG) score by Sustainanlytics aggregated by firm age (firm age is calculated as the difference between firm IPO year and the reporting fiscal year)

Table 9.
Samples excluding financial institutions

Panel A: Total effect

Variable	F_DISP (1)	F_DISP (2)
CSR	0.0004	0.0010
	(0.11)	(1.47)
CG		−0.0005
		(−0.54)
Controls	Yes	Yes
Intercept	0.7322***	0.7309***
	(7.01)	(6.99)
Fixed effects	Year, industry	Year, industry
Adj. R^2	0.0400	0.1572
F-statistics	14.61	47.68
N	7,255	7,255

Panel B: Mediation effect

Variable	F_DISP (1)	F_DISP CG (2)	F_DISP (3)
CSR	−0.0018***	0.6003***	−0.0016**
	(−13.74)	(420.09)	(−2.47)
CG			−0.0003
			(−0.27)
Sobel test		$\beta_1 = -0.0018$***	
		$\alpha_1 = 0.6003$***, $\beta_2 = -0.0003$	
		$\beta_1' = -0.00016$**	
		Sobel test *z*-stat = |1.0679| > |0.97|	
Mediation effect		Partial mediation	
N		7,255	

Notes: This table presents the results for the sample without financial institutions. The first row (number) represents the estimated coefficient, and the second row (number in parentheses) represents the *t-values* of significance. Variable definition is presented in Appendix 1; **if $p < 0.05$; ***if $p < 0.01$. All tests are two-tailed and cluster robust standard errors are used in the estimation

Sobel test. Our interpretations of coefficients are as follows: an increase of one unit in CSR causes a decrease of analyst forecast dispersion by 0.18 basis points (Column 1 of Panel B); an increase of one unit in CSR causes an of CG by 0.6% (Column 2 of Panel B); and withholding the partially mediation effect from CSR → CG, an increase of one unit in CSR mediating from CG causes a further decrease of analyst forecast dispersion by 0.16 basis points (Column 3 of Panel B). Hence, the significant partial mediating relationship is confirmed, and our results are robust after excluding financial institutions.

6. Conclusion

This study explored the relationship between CSR and analyst forecast quality and examined the mediation effect of CG. Our results reveal that CG acts as a partial mediator affecting the relationship between CSR and analyst forecast quality, and the mediating role of CG is muted in firms with low level of CG mechanism. Further, our results show that for firms committing to excess CSR, CG also plays a partial mediating role in facilitating CSR's positive influence on forecast quality.

This study offers two incremental contributions. First, to the best of the authors' knowledge, this is the first study to explicitly investigate the role of CG as a mediator between CSR and analyst quality. Second, after splitting CSR into expected CSR and excess CSR, we obtain results that support the signaling hypothesis, indicating that excess CSR engagement by some firms enhances analyst forecast quality through CG as a mediator. Overall, our findings add to extant literature on the nexus of CSR, CG and information asymmetry by providing strong evidence that CG complements CSR to enhance analyst forecast quality.

Several policy implications can be drawn from this study. First, the evidence on the mediation effect of CG between CSR and analyst forecast quality is useful for corporate management and market participants. For instance, to enhance forecast quality, firms can engage in CSR. Even though CSR may relate to greenwashing incentives or long-term wealth creation, and may not immediately add to forecast quality, CG will play a crucial role in mediating the tension between analyst forecast quality and CSR by potentially eliminating the adverse effect of greenwashing CSR.

Notes

1. A partial mediation means that CSR can increase analyst forecast quality directly, as well as through the indirect effect of CG as a mediator on analyst forecast quality.
2. We acknowledge that prior literature has studied CG's moderating effect on CSR and firm-level outcome variables (Wang and Sarkis, 2017). Our study on CG's mediation effect does not preclude its moderating role. Our prime purpose is to conduct empirical analysis to test whether the mediator role of CG may exist in the current context of CSR–analyst forecast quality relationship. The moderating role of CG is interesting, but not the focus of current study.
3. The definition of CSR signaling is similar to that of signaling through dividend changes, which has considerable implications for future firm performance but has no effect on whether a firm conveys such information (Miller and Rock, 1985).
4. Our sample includes financial firms. In Section 5.3, we repeat the analyses by excluding financial firms because they are heavily regulated and tend to have higher leverage. The results are unchanged.
5. The corporate governance score by Sustainalytics provides a composite measure across 43 multiple corporate governance items. Social and environmental CSR scores are measured by 61

and 59 items, respectively. More details on the Sustainalytics methodology are available at: www.sustainalytics.com/esg-ratings.

6. This log transformation is similar to one used in Lee and Liu (2011), for the consideration of minimizing potential bias of results caused by extreme values of analyst earning forecast error; 0.0001 is added to the raw forecast error to avoid the circumstance of log(0), whereby the analyst forecast equals earnings per share (i.e. $F\_ERR = 0$).

7. Sustainalytics provides detailed profiles of 163 items in collaboration with its national partners, who are requested to scrutinize their social dimensions of the main corporations in its respective home markets. Information collected to build the items for corporate sustainable performance is extracted from multiple sources, including corporate reports and documentation, external databases, media, and interviews with corporate stakeholders. Similar to KLD, the 163 items cover various sustainability dimensions, and all information items are weighted according to a sector-specific methodology developed by Sustainalytics and are updated annually. The final score given by Sustainalytics is the sum of the items covered under each sustainability dimension averaged by its corresponding weight and rated on a scale from 0 to 100. The overall environmental, social and governance score is broken down into a dimensional level, and each environmental, social and governance component receives a rating. Note that these dimensions are similar to those from the KLD data used in other research (e.g. Adhikari, 2016; Dutordoir *et al.*, 2018; Sun and Gunia, 2018).

8. While PSM is commonly used in many studies, such as Kim and Shi (2012), Morsfield and Tan (2006), Doyle *et al.* (2007) and Lennox *et al.* (2012), it should be noted that there are biases involved in the selection of firms to form control sample using this method (Hainmueller, 2012). As such, we mitigate the relative importance of PSM as the main methodological approach for our paper.

9. It is also noted by Baron and Kenny (1986) that these conditions are based on the coefficient estimates, as well as on the statistical significance.

10. A critical ratio Z^3 is yielded using $(a_1 \times \beta_2)$ divided by the standard error f indirect effect $(S_{a_1\beta_2})^2$. It is used to compare with the critical value under Sobel test derived from a standard normal distribution.

11. Note that these results are based on the full sample inclusive of firms from the financial industry. These firms are excluded in subsequent robustness tests in Section 5.3.

12. The Sobel method provides a significance test for the indirect effect of the independent variable on the dependent variable via the mediator based on the path from the independent variable to the mediator (β_1) and its standard error, as well as on the path from the mediator to the dependent variable (β_2) and its standard error (Sobel, 1982). In our case, if the Sobel test proves that the effect from β_2 (0.0002) (i.e. the path from CG to F_DISP) is trivial, we reject the mediation model (see Sobel, 1982; Baron and Kenny, 1986).

13. It is worth noting the significance revealed in the Sobel test. The convergence of the Sobel test is heavily reliant on the coefficient estimate of a_1 and β_2, as well as on the standard residuals derived under the two paths. As shown in Column 2 in Panel B from Table 4, we notice that both the significance and the coefficient estimate for the path for a_1 is substantial, which further and mainly drives the Sobel test to be significant. Therefore, our results indicate that the channel from CSR to CG is vital in forming the indirect effect of CSR via CG on F_DISP.

14. Note that the partial mediation of CG exists between CSR and ERR because the absolute value of Sobel test z-value is greater than the critical z-value of 0.97 ($|-1.2676| > |0.97|$).

15. Again, Sobel test involves computing the ratio of a_1 and β_2 (Sobel, 1982, 1986). When validating the significance of the partial mediation via the Sobel test, we find in this case that the z-value is less than the absolute critical value ($|0.4663| < |0.97|$), indicating no mediation effect of CG in the

relationship between CSR and analyst forecast quality among the underperforming CG sample group.

References

Adhikari, B.K. (2016), "Causal effect of analyst following on corporate social responsibility", *Journal of Corporate Finance*, Vol. 41, pp. 201-216, doi: 10.1016/j.jcorpfin.2016.08.010.

Al-Hadi, A., Chatterjee, B., Yaftian, A., Taylor, G. and Monzur Hasan, M. (2019), "Corporate social responsibility performance, financial distress and firm life cycle: evidence from Australia", *Accounting and Finance*, Vol. 59 No. 2, pp. 961-989, doi: 10.1111/acfi.12277.

Asquith, P., Mikhail, M.B. and Au, A.S. (2005), "Information content of equity analyst reports", *Journal of Financial Economics*, Vol. 75 No. 2, pp. 245-282, doi: 10.1016/j.jfineco.2004.01.002.

Balkanska, D.V. (2018), "Disposition effect and analyst forecast dispersion", *Review of Quantitative Finance and Accounting*, Vol. 50 No. 3, pp. 837-859, doi: 10.1007/s11156-017-0648-7.

Baron, R.M. and Kenny, D.A. (1986), "The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations", *Journal of Personality and Social Psychology*, Vol. 51 No. 6, pp. 1173-1182, doi: 10.1037/0022-3514.51.6.1173.

Becchetti, L., Ciciretti, R. and Hasan, I. (2015), "Corporate social responsibility, stakeholder risk, and idiosyncratic volatility", *Journal of Corporate Finance*, Vol. 35, pp. 297-309, doi: 10.1016/j.jcorpfin.2015.09.007.

Beddewela, E. and Fairbrass, J. (2016), "Seeking legitimacy through CSR: institutional pressures and corporate responses of multinationals in Sri Lanka", *Journal of Business Ethics*, Vol. 136 No. 3, pp. 503-522, doi: 10.1007/s10551-014-2478-z.

Beekes, W. and Brown, P. (2006), "Do better-governed Australian firms make more informative disclosures?", *Journal of Business Finance and Accounting*, Vol. 33 Nos 3/4, pp. 422-450, doi: 10.1111/j.1468-5957.2006.00614.x.

Behn, B.K., Choi, J.-H. and Kang, T. (2008), "Audit quality and properties of analyst earnings forecasts", *The Accounting Review*, Vol. 83 No. 2, pp. 327-349, doi: 10.2308/accr.2008.83.2.327.

Boubakri, N., Guedhami, O., Kwok, C.C.Y. and Wang, H.H. (2019), "Is privatization a socially responsible reform?", *Journal of Corporate Finance*, Vol. 56, pp. 129-151, doi: 10.1016/j.jcorpfin.2018.12.005.

Brav, A. and Lehavy, R. (2003), "An empirical analysis of analysts' target prices: short-term informativeness and long-term dynamics", *The Journal of Finance*, Vol. 58 No. 5, pp. 1933-1967, doi: 10.1111/1540-6261.00593.

Byard, D., Li, Y. and Weintrop, J. (2006), "Corporate governance and the quality of financial analysts' information", *Journal of Accounting and Public Policy*, Vol. 25 No. 5, pp. 609-625, doi: 10.1016/j.jaccpubpol.2006.07.003.

Chan, K. and Hameed, A. (2006), "Stock price synchronicity and analyst coverage in emerging markets", *Journal of Financial Economics*, Vol. 80 No. 1, pp. 115-147, doi: 10.1016/j.jfineco.2005.03.010.

Chen, Y.C., Hung, M. and Wang, Y. (2018), "The effect of mandatory CSR disclosure on firm profitability and social externalities: evidence from China", *Journal of Accounting and Economics*, Vol. 65 No. 1, pp. 169-190, doi: 10.1016/j.jacceco.2017.11.009.

Cheung, A. (2016), "Corporate social responsibility and corporate cash holdings", *Journal of Corporate Finance*, Vol. 37, pp. 412-430, doi: 10.1016/j.jcorpfin.2016.01.008.

Crawford, S.S., Roulstone, D.T. and So, E.C. (2012), "Analyst initiations of coverage and stock return synchronicity", *The Accounting Review*, Vol. 87 No. 5, pp. 1527-1553, doi: 10.2308/accr-50186.

Dasgupta, S., Gan, J. and Gao, N. (2010), "Transparency, price informativeness, and stock return synchronicity: theory and evidence", *Journal of Financial and Quantitative Analysis*, Vol. 45 No. 5, pp. 1189-1220, doi: 10.1017/S0022109010000505.

Deegan, C. (2014), "An overview of legitimacy theory as applied within the social and environmental accounting literature", in Bebbington, J., Unerman, J. and O'Dwyer, B. (Eds), *Sustainability Accounting and Accountability*, Routledge, ISBN 9780415695589, pp. 248-272.

Dhaliwal, D.S., Li, O.Z., Tsang, A. and Yang, Y.G. (2011), "Voluntary nonfinancial disclosure and the cost of equity capital: the initiation of corporate social responsibility reporting", *The Accounting Review*, Vol. 86 No. 1, pp. 59-100, doi: 10.2308/accr.00000005.

Doyle, J., Ge, W. and McVay, S. (2007), "Accruals quality and internal control over financial reporting", *The Accounting Review*, Vol. 82 No. 5, pp. 1141-1170.

Dutordoir, M., Strong, N.C. and Sun, P. (2018), "Corporate social responsibility and seasoned equity offerings", *Journal of Corporate Finance*, Vol. 50, pp. 158-179, doi: 10.1016/j.jcorpfin.2018.03.005.

Felo, A.J., Kim, J.W. and Lim, J.H. (2018), "Can XBRL detailed tagging of footnotes improve financial analysts's information environment?", *International Journal of Accounting Information Systems*, Vol. 28, pp. 45-58, doi: 10.1016/j.accinf.2017.12.003.

Fernandez, P. Aguirreamalloa, J. and Avendaño, L.C. (2011), "US market risk premium used in 2011 by professors, analysts and companies: a survey with 5.731 answers", available at: SSRN: https://ssrn.com/abstract=1805852

Ferreira, M. and Laux, P. (2007), "Corporate governance, idiosyncratic risk, and information flow", *The Journal of Finance*, Vol. 62 No. 2, pp. 951-989, doi: 10.1111/j.1540-6261.2007.01228.x.

Graafland, J.J., Eijffinger, S.C. and SmidJohan, H. (2004), "Benchmarking of corporate social responsibility: methodological problems and robustness", *Journal of Business Ethics*, Vol. 53 Nos 1/2, pp. 137-152, doi: 10.1023/B:BUSI.0000039404.67854.e1.

Gul, F.A., Srinidhi, B. and Ng, A.C. (2011), "Does board gender diversity improve the informativeness of stock prices?", *Journal of Accounting and Economics*, Vol. 51 No. 3, pp. 314-338, doi: 10.1016/j.jacceco.2011.01.005.

Hadlock, C.J. and James, C.M. (2002), "Do banks provide financial slack?", *The Journal of Finance*, Vol. 57 No. 3, pp. 1383-1419, doi: 10.1111/1540-6261.00464.

Hainmueller, J. (2012), "Entropy balancing for causal effects: a multivariate reweighting method to produce balanced samples in observational studies", *Political Analysis*, Vol. 20 No. 1, pp. 25-46, doi: 10.1093/pan/mpr025.

Harjoto, M.A. and Jo, H. (2015), "Legal vs. normative CSR: differential impact on analyst dispersion, stock return volatility, cost of capital, and firm value", *Journal of Business Ethics*, Vol. 128 No. 1, pp. 1-20, doi: 10.1007/s10551-014-2082-2.

Hillman, A.J. and Keim, G.D. (2001), "Shareholder value, stakeholder management, and social issues: what's the bottom line?", *Strategic Management Journal*, Vol. 22 No. 2, pp. 125-139, doi: 10.1002/1097-0266(200101)22:2≤125::AID-SMJ150≥3.0.CO;2-H.

Hutton, A.P., Marcus, A.J. and Tehranian, H. (2009), "Opaque financial reports, R^2, and crash risk", *Journal of Financial Economics*, Vol. 94 No. 1, pp. 67-86, doi: 10.1016/j.jfineco.2008.10.003.

Jo, H. and Harjoto, M.A. (2012), "The causal effect of corporate governance on corporate social responsibility", *Journal of Business Ethics*, Vol. 106 No. 1, pp. 53-72, doi: 10.1007/s10551-011-1052-1.

Jo, H. and Na, H. (2012), "Does CSR reduce firm risk? Evidence from controversial industry sectors", *Journal of Business Ethics*, Vol. 110 No. 4, pp. 441-456, doi: 10.1007/s10551-012-1492-2.

Kenny, D.A., Kashy, D.D. and Bolger, N. (1998), "Data analysis in social psychology", in Gilbert, D., Fiske, S. and Lindzey, G. (Eds), *The Handbook of Social Psychology*, McGraw-Hill, Boston, MA, pp. 233-265.

Kim, Y., Li, H. and Li, S. (2014), "Corporate social responsibility and stock price crash risk", *Journal of Banking and Finance*, Vol. 43, pp. 1-13, doi: 10.1016/j.jbankfin.2014.02.013.

Kim, J.B. and Shi, H. (2012), "IFRS reporting, firm-specific information flows, and institutional environments: international evidence", *Review of Accounting Studies*, Vol. 17 No. 3, pp. 474-517, doi: 10.1007/s11142-012-9190-y.

Lee, D.W. and Liu, M.H. (2011), "Does more information in stock price lead to greater or smaller idiosyncratic return volatility?", *Journal of Banking and Finance*, Vol. 35 No. 6, pp. 1563-1580, doi: 10.1016/j.jbankfin.2010.11.002.

Lee, K., Oh, W.Y. and Kim, N. (2013), "Social media for socially responsible firms: analysis of fortune 500's Twitter profiles and their CSR/CSIR ratings", *Journal of Business Ethics*, Vol. 118 No. 4, pp. 791-806, doi: 10.1007/s10551-013-1961-2.

Lennox, C., Francis, J. and Wang, Z. (2012), "Selection models in accounting research", *The Accounting Review*, Vol. 87 No. 2, pp. 589-616.

Lennox, C.S. and Park, C.W. (2006), "The informativeness of earnings and management's issuance of earnings forecasts", *Journal of Accounting and Economics*, Vol. 42 No. 3, pp. 439-458, doi: 10.1016/j.jacceco.2006.05.001.

Lu, Y. and Abeysekera, I. (2017), "What do stakeholders care about? Investigating corporate social and environmental disclosure in China", *Journal of Business Ethics*, Vol. 144 No. 1, pp. 169-184, doi: 10.1007/s10551-015-2844-5.

Lyon, T.P. and Maxwell, J.W. (2011), "Greenwash: corporate environmental disclosure under threat of audit", *Journal of Economics and Management Strategy*, Vol. 20 No. 1, pp. 3-41, doi: 10.1111/j.1530-9134.2010.00282.x.

Lys, T., Naughton, J.P. and Wang, C. (2015), "Signaling through corporate accountability reporting", *Journal of Accounting and Economics*, Vol. 60 No. 1, pp. 56-72, doi: 10.1016/j.jacceco.2015.03.001.

McWilliams, A. and Siegel, D. (2001), "Corporate social responsibility: a theory of the firm perspective", *Academy of Management Review*, Vol. 26 No. 1, pp. 117-127, doi: 10.5465/amr.2001.4011987.

Matten, D. and Moon, J. (2008), "'Implicit' and 'explicit' CSR: a conceptual framework for a comparative understanding of corporate social responsibility", *Academy of Management Review*, Vol. 33 No. 2, pp. 404-424, doi: 10.5465/amr.2008.31193458.

Miller, M.H. and Rock, K. (1985), "Dividend policy under asymmetric information", *The Journal of Finance*, Vol. 40 No. 4, pp. 1031-1051, doi: 10.1111/j.1540-6261.1985.tb02362.x.

Morsfield, S. and Tan, C. (2006), "Do venture capitalists influence the decision to manage earnings in initial public offerings?", *The Accounting Review*, Vol. 81 No. 5, pp. 1119-1150.

Oh, W.Y., Chang, Y.K. and Kim, T.Y. (2018), "Complementary or substitutive effects? Corporate governance mechanisms and corporate social responsibility", *Journal of Management*, Vol. 44 No. 7, pp. 2716-2739, doi: 10.1177/0149206316653804.

Oh, W.Y., Chang, Y.K. and Martynov, A. (2011), "The effect of ownership structure on corporate social responsibility: empirical evidence from Korea", *Journal of Business Ethics*, Vol. 104 No. 2, pp. 283-297, doi: 10.1007/s10551-011-0912-z.

Orlitzky, M. (2013), "Corporate social responsibility, noise, and stock market volatility", *Academy of Management Perspectives*, Vol. 27 No. 3, pp. 238-254, doi: 10.5465/amp.2012.0097.

Orlitzky, M., Siegel, D.S. and Waldman, D.A. (2011), "Strategic corporate social responsibility and environmental sustainability", *Business and Society*, Vol. 50 No. 1, pp. 6-27, doi: 10.1177/0007650310394323.

Pástor, Ľ. and Pietro, V. (2003), "Stock valuation and learning about profitability", *The Journal of Finance*, Vol. 58 No. 5, pp. 1749-1789, doi: 10.1111/1540-6261.00587.

Piotroski, J.D. and Roulstone, D.T. (2004), "The influence of analysts, institutional investors, and insiders on the incorporation of market, industry, and firm-specific information into stock prices", *The Accounting Review*, Vol. 79 No. 4, pp. 1119-1151, doi: 10.2308/accr.2004.79.4.1119.

Preacher, K.J. and Hayes, A.F. (2004), "SPSS and SAS procedures for estimating indirect effects in simple mediation models", *Behavior Research Methods, Instruments, and Computers*, Vol. 36 No. 4, pp. 717-731, doi: 10.3758/BF03206553.

Rezaee, Z. (2009), *Corporate Governance and Ethics*, John Wiley and Sons, Hoboken, NJ.

Rowley, T. and Berman, S. (2000), "A brand new brand of corporate social performance", *Business and Society*, Vol. 39 No. 4, pp. 397-418, doi: 10.1177/000765030003900404.

Sobel, M.E. (1982), "Asymptotic confidence intervals for indirect effects in structural equation models", *Sociological Methodology*, Vol. 13, pp. 290-312.

Sobel, M.E. (1986), "Some new results on indirect effects and their standard errors in covariance strcture models", in Tuma, N. (Ed.), *Sociological Methdology 1982*, Jossey-Bass, San Francisco, pp. 290-312, doi: 10.2307/270922.

Sun, X. and Gunia, B.C. (2018), "Economic resources and corporate social responsibility", *Journal of Corporate Finance*, Vol. 51, pp. 332-351, doi: 10.1016/j.jcorpfin.2018.06.009.

Surroca, J., Tribó, J.A. and Waddock, S. (2010), "Corporate responsibility and financial performance: the role of intangible resources", *Strategic Management Journal*, Vol. 31 No. 5, pp. 463-490, doi: 10.1002/smj.820.

Wang, Z. and Sarkis, J. (2017), "Corporate social responsibility governance, outcomes, and financial performance", *Journal of Cleaner Production*, Vol. 162, pp. 1607-1616, doi: 10.1016/j.jclepro.2017.06.142.

Wu, W., Peng, F., Shan, Y.G. and Zhang, L. (2020), "Litigation risk and firm performance: the effect of internal and external corporate governance", *Corporate Governance: An International Review*, Vol. 28 No. 4, pp. 210-239, doi: 10.1111/corg.12319.

Wu, M.W. and Shen, C.H. (2013), "Corporate social responsibility in the banking industry: motives and financial performance", *Journal of Banking and Finance*, Vol. 37 No. 9, pp. 3529-3547, doi: 10.1016/j.jbankfin.2013.04.023.

Further reading

Du, S., Bhattacharya, C.B. and Sen, S. (2010), "Maximizing business returns to corporate social responsibility (CSR): the role of CSR communication", *International Journal of Management Reviews*, Vol. 12 No. 1, pp. 8-19, doi: 10.1111/j.1468-2370.2009.00276.x.

GRI (2019), "Sustainability reporting guidelines", available at: www2.globalreporting.org/resourcelibrary/GRIG4-Part1-Reporting-Principles-and-Standard-Disclosures.pdf (accessed 24/11/2019).

Yoon, Y., Gurhan-Canli, Z. and Schwarz, N. (2006), "The effect of corporate social responsibility (CSR) activities on companies with bad reputations", *Journal of Consumer Psychology*, Vol. 16 No. 4, pp. 377-390, doi: 10.1207/s15327663jcp1604_9.

Appendix 1

Table A1.
Variable definition

Panel A: Analyst forecast quality	
F_DISP	F_DISP is analyst forecast dispersion, measured as the standard deviation of the forecast earnings per share (EPS) divided by the mean forecast, then average over the year
ERR	ERR is analyst earnings forecast error, measured by the absolute value of the difference between the mean earnings forecast for the next fiscal year and the actual EPS
Panel B: Corporate social responsibility	
CSR	CSR is corporate social responsibility score including firm-level environmental and social performance from Sustainalytics
ENV	ENV is environmental performance score sourced from Sustainalytics
SO	SO is social performance score sourced from Sustainalytics
CG	CG is corporate governance score sourced from Sustainalytics
CSR_exs	CSR_exs is industry excess CSR, measured by the difference between firm-level CSR and industry CSR median
CG_D	A dummy variable coded 1 if a firm has been given a corporate governance score by Sustainalytics, and 0 otherwise
CSR_D	A dummy variable coded 1 if a firm has been given a CSR score by Sustainalytics, and 0 otherwise
age_CSR	age_CSR is the average CSR score by Sustainanlytics aggregated by firm age. We calculate firm age as the difference between firm IPO year and the reporting fiscal year
age _CG	age_CG is the average CG score by Sustainanlytics aggregated by firm age. We calculate firm age as the difference between firm IPO year and the reporting fiscal year
Panel C: Control variables	
SIZE	SIZE is firm size, measured as the natural logarithm of a firm's market capitalization as of the end of fiscal year
MB	MB is market-to-book ratio, measured as market capitalization divided by the book value of equity as of the end of fiscal year
LEV	LEV is leverage level, measured as total long-term debt divided by total assets as of the end of fiscal year
ROA	ROA is return on assets, measured as income before extraordinary items divided by total assets as of the end of fiscal year
V_ROA	V_ROA is volatility of return, measured as the standard deviation of the ratio between income before extraordinary items and total assets in the past five years
N_ANA	N_ANA is analysts' coverage, measured as the number of analysts following the firm for the fiscal year
IND_COMP	IND_COMP is Herfindahl index, measured as the sum of the squared terms of the proportion of a firm's revenue to total revenue in the industry to which firm belongs
IND_SIZE	IND_SIZE is industry size, measured as the natural logarithm of the number of firms in the industry to which firm *i* belongs
Panel D: PSM variables	
CSRD	CSRD is a dichotomous variable that measures whether a firm has been given a score by Sustainalytics. If a firm has shown CSR reporting, coded as 1, 0 otherwise
FS	FS is firm size by book value, measured as the natural logarithm of a firm's total asset
PFM	PFM is firm performance, measured by return on asset, where income before extraordinary items divided by total asset of the end of fiscal year
LEV	LEV is leverage level, measured as total long-term debt divided by total assets as of the end of fiscal year
IND	IND is the CSR sensitive industry identified by Dhaliwal *et al.* (2011), including the US SIC codes 2833–2836, 3570–3577, 3600–3674, 5200–5961 and 7370
AGE	AGE is firm age, measured as a sample firm's listing years

Appendix 2

Variable	Dep. Var = CSRD
Panel A: Logit model used for PSM	
FD	1.1636***
	(45.24)
PFM	1.4633***
	(7.14)
LEV	0.2934***
	(2.90)
IND	0.1311**
	(2.19)
AGE	0.0644***
	(3.339)
Intercept	−9.5995***
	(−35.50)
Fixed effects	Industry, year
Adjust R^2	0.4904
N	8,426

Panel B: Test of the effectiveness of PSM

Variable		Mean for treatment firms (1)	Mean for benchmark firms (2)	*t*-Test *p*-value (1)–(2)
FD	Pre-match	9.02	6.29	0.01***
	Post-match	8.96	7.18	0.01***
PFM	Pre-match	0.05	−0.07	0.01***
	Post-match	0.06	0.04	0.01***
LEV	Pre-match	0.25	0.18	0.01***
	Post-match	0.25	0.22	0.01***
IND	Pre-match	0.21	0.24	0.01***
	Post-match	0.21	0.16	0.01***
AGE	Pre-match	8.53	7.99	0.01***
	Post-match	8.58	8.43	0.01***

Notes: Appendix 2 describes the PSM approach. We first estimated a logit regression to model the propensity of a CSR (treatment) firm, and then match with the control firms using the nearest neighbor matching technique with 1:1 ratio. We follow Chen *et al.* (2018) by having PSM with replacement and calliper set at 0.25^{*} standard error of propensity score. Panel A shows the estimation results of the logit model, and Panel B shows the mean difference between the sample from pre- and post-matching. A *t*-test is also performed to show the effectiveness of PSM. Variable definition is presented in Appendix 1; **if $p < 0.05$; ***if $p < 0.01$. All tests are two-tailed

Table A2. Propensity score matching samples

Corresponding author
Yuan George Shan can be contacted at: george.shan@uwa.edu.au