CEO Profile and Earnings Quality[*]

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Abstract

This paper introduces the PSCORE, which aggregates nine personal characteristics of chief executive officers (CEOs), to signal the quality of earnings. The PSCORE is a composite score based on publicly available data on CEOs. The study reports strong positive relationships between the PSCORE and two different proxies for earnings quality, (i) discretionary accruals and (ii) financial statement errors, measured by deviations of the first digits of figures reported in financial statements from those expected by Benford's Law. Further analyses indicate that the relationships between the PSCORE and the proxies for earnings quality become more pronounced when CEOs have high equity-based compensation incentives. The findings have some implications for practitioners.

Keywords: Earnings Quality; Benford's Law; Chief Executive Officers

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1 Introduction

A substantial body of the existing research is committed to developing, validating, and improving empirical models estimating earnings quality. This paper contributes to this emerging seam of literature by introducing a novel approach that uses publicly available information on the personal profiles of chief executive officers (hereafter CEOs) to red flag poor earnings quality in individual firms.

An accepted methodology for capturing earnings quality is to estimate discretionary accruals (Dechow et al. 2010). Discretionary accruals are the residuals (or error terms) in the regressions between accruals and firms' characteristics (e.g., Jones 1991; Dechow et al. 1995; Dechow and Dichev 2002; Kothari et al. 2005). Despite their importance, earnings quality models are subject to considerable criticism. A major limitation of accrual-based models is the absence of an adequate understanding of the properties of accruals and a theory of the accrual-generating process, such that large-magnitude regression residuals may be taken to infer poor quality of earnings (Fields et al. 2001; Dechow et al. 2010; Gerakos 2012; Ball 2013; Jackson 2018). There is also increasing concern that accrual-based models are poorly specified (Holthausen et al. 1995; Fields et al. 2001; Dechow et al. 2010; Ball 2013), that there may be measurement errors in estimating accruals (Hribar and Collins 2002), and that there may be statistical biases in the inferences made about earnings management (Christodoulou et al. 2018; McNichols and Stubben 2018). Also, as most models require large datasets in order for time-series or cross-sectional regressions to be run, their application remains limited because of data constraints (Dechow et al. 1995; Dechow et al. 2011; Amiram et al. 2015; Nguyen et al. 2015).

Although there are theories that support the notion of the profile of the CEO playing an influential role in determining earnings quality, the existing literature in this area is relatively underdeveloped. For example, the upper echelons theory proposes that the decision-making process of executive managers is influenced by individual managers' interpretation of the strategic situations they face, and that such interpretations could, in turn, be affected by personal characteristics such as experience and personality, among others (Hambrick and Mason 1984; Hambrick 2007). The upper echelons theory predicts that organizational outcomes are directly determined by the discretion of top executive managers (Hambrick et al. 2005). Given that CEOs have overall responsibility for firm performance, it is reasonable to assume that they can indeed influence the financial statements that present the financial performance, financial position, and cash flows of their companies. Because accounting standards allow the use of professional judgment in the choice of appropriate accounting policies or estimation of accounting numbers, when uncertainties exist, this makes the characteristics of CEOs relevant to the financial decision-making process and worthy of closer inspection.

Also, under the efficient contracting theory (e.g., Francis et al. 2008; Jian and Lee 2011), CEOs with high credibility (such as a good reputation) produce high-quality organizational outcomes because they have more to lose (compensation, future career, etc.) if they are involved in harmful activities. Recently, Liang et al. (2018) have offered a theory on the relationship between the credibility of financial reporting and the credibility of managers. The authors theorize that, because of limited tenure or the horizon problem (Dechow and Sloan 1991), managers have an incentive to maximize the stock price at the time of their retirement. Liang and colleagues also find that dishonest managers can choose to manage earnings and that discretionary accruals are higher and more volatile in firms with less credible CEOs. What the model of Liang et al. (2018) tells us is that we can use CEOs' profiles to study earnings quality.

In this paper, we offer a single measure that captures various CEO characteristics and uses them to signal earnings quality. We construct a proxy that we name the PSCORE, based on nine CEO characteristics that have previously been documented in the accounting literature to be important determinants of earnings quality. Specifically, the PSCORE utilizes (i) role experience as a CEO, (ii) previous working experience as a chief financial officer, (iii) finance-related qualifications, (iv) early years of service in the firm, (v) performance during the last three years of tenure, (vi) press coverage, (vii) CEO serving as chairperson, (viii) CEO who is a founder of the firm, and (ix) age. This paper tests whether the PSCORE is positively correlated with other established proxies for earnings quality.

The research employs established proxies for earnings quality, acknowledging recent developments in the field. We use two different types of earnings quality measures: (i) discretionary accruals (Jones 1991; Dechow et al. 1995; Peasnell et al. 2000) and (ii) financial statement errors, measured by deviations of the first digits of figures reported in financial statements from those expected by Benford's Law (Amiram et al. 2015; Nigrini 2015).

The research uses a sample of 3,395 firm-year observations (615 unique firms) of companies listed on the London Stock Exchange from 2005 to 2012. Consistent with predictions, the results demonstrate strong positive relationships between the PSCORE and the established proxies for earnings quality. Specifically, the univariate evidence shows that the levels of both earnings quality proxies increase monotonically as the PSCORE increases. The multivariate regression findings show that the PSCORE is positively and significantly related to the magnitudes of discretionary accruals and deviations of first digits from Benford's Law, after controlling for important determinants of earnings quality. Further analyses indicate that the relationships between the PSCORE and the established proxies for earnings quality are stronger for firms with CEOs with higher equity-based incentives. The evidence substantiates the proposition that the personal profiles of CEOs do matter for earnings quality. The results remain robust even after introducing manipulation checks, e.g. when we include a proxy for CEO overconfidence in the PSCORE, and when we use proxies for real earnings management as an alternative measure of earnings quality.

Our research findings contribute to the literature and practice, as follows. Firstly, as the data used to construct the PSCORE are available in the public domain, as they form part of CEOs' curriculum vitae, the PSCORE is easy to obtain. Also, because neither time-series nor cross-sectional data are required for estimating the PSCORE, it can be widely applied, which is especially important in capital markets where data are not publicly available or are costly to collect. Secondly, the paper is the first research attempt to aggregate various characteristics of CEOs into a single index that can be used to signal quality of earnings. Previously published attempts have been limited to the effects of a few individual CEO characteristics on earnings quality (e.g., Francis et al. 2008; Malmendier and Tate 2009; Jiang et al. 2010; Huang et al. 2012; Kuang et al. 2014; Ali and Zhang 2015). Our paper also provides some empirical evidence to support the theoretical framework of Liang et al. (2018) on the relationship between CEO's credibility and earnings quality. Thirdly, this paper makes a novel and original contribution as it uses CEO characteristics to signal the presence of financial statement errors, as a result of costly material misstatements. As the PSCORE can signal the likelihood of misrepresentation of financial statements, regardless of whether they result from intentional or unintentional acts, it is of value to practice.

The PSCORE could be a useful tool for auditors, boards of directors, and investment professionals, in aiding the assessment of the risks of poor earnings quality. It also has the potential to identify and thus regulate risks related to financial reporting quality. For example, external auditors could use the PSCORE to assess the risks of material misstatements. Auditing standards (e.g., International Auditing and Assurance Standards Board (IAASB) 2009; Public Company Accounting Oversight Board 2010) require the risk assessment procedures of auditors to include an understanding of the entity and its environment, including the management's philosophy and operating style. High discretionary accruals and large financial statement errors, which are associated with a high PSCORE, could result from the inappropriate application of accounting standards, meaning that they could act as red flags for material accounting misstatements. The evidence implies that auditors should be cautious when dealing with firms with high-PSCORE CEOs.

The remainder of the paper proceeds as follows. We first explain the construction of the PSCORE and the hypothesis development. Then, we describe the methodology used to test the validity of the PSCORE, focusing on sample selection, the calculation of empirical proxies for earnings quality, and the multivariate regression models. After that, we provide findings and conclusions.

2 Construction of the PSCORE and hypothesis development

The PSCORE covers nine aspects of CEO characteristics that have been identified in the existing literature as being correlated with earnings quality. Individual characteristics can be categorized into financial expertise (experience in role, previous working experience as a chief financial officer, and advanced finance-related qaualification/certification), reputation (performance during the last three year of CEO tenure, early years of service of CEOs in a firm, and press coverage), internal power (CEOs serving as the chairperson of the board of directors and CEOs serving as the founder or co-founder of the firms), and age. Our general approach is that we create indicator variables taking the value of 1 if previous research has shown that a particular individual factor is associated with poor earnings quality, and 0 otherwise. We briefly discuss related literature on each individual characteristic in the following paragraphs.

2.1 Financial expertise

The existing literature documents financial expertise as a determinant of earnings quality. The financial expertise of audit committees has been found to be positively correlated with earnings quality (Bédard et al. 2004; Badolato et al. 2014). Similarly, Aier et al. (2005) demonstrate that the financial expertise of chief financial officers helps to improve earnings quality, e.g., by reducing earnings restatements. They argue that chief financial officers with high financial expertise are less likely to be involved in earnings restatements because they will play a better role in designing and implementing internal control and financial reporting processes, resulting in higher earnings quality. Financial expertise is also important for CEOs because they have a legal duty to sign off on the true and fair financial statements of their companies. For example, Gounopoulos and Pham (2018) find that financial expert CEOs help to reduce earnings management around initial public offerings.[2] In this paper, we expect that the financial expertise of CEOs is likely to be associated with high earnings quality.

[2] This evidence is also consistent with the work of Custódio and Metzger (2014), which shows that financial expert CEOs lead to favourable financial outcomes for firms.

In line with the above evidence, the first three factors of the PSCORE are financial expertise proxies. Following Aier et al. (2005), we measure financial expertise using CEOs' role experience (*pROLE*), experience as a chief financial officer *(pCFO)*, and advanced finance-related certification (*pCERT*). Details of the variable calculations are presented as an appendix. The rationale for using these three proxies is that CEOs may have different ways of gaining financial expertise. Experience in the role of CEO will help them to do so. CEOs may also gain financial expertise working as a chief financial officer because that position is directly responsible for the preparation of financial statements. Finally, studying for an advanced finance-related certification would be a way to gain such expertise.[3]

2.2 Reputation

The next group of individual factors of the PSCORE are related to the reputation of CEOs. Admittedly, there is mixed evidence on the impact of CEOs' reputation on earnings quality. Some previous studies show that a good reputation is associated with low earnings quality, including Malmendier and Tate (2009), who find that award-winning, "superstar" CEOs inflate reported earnings and extract higher compensation. Similarly, Wade et al. (2006) find a negative relationship between the reputation of "celebrity" CEOs and organizational outcomes in the long term. However, the above-mentioned studies remain outliers, as more studies (Francis et al., 2008; Jian & Lee, 2011; Milbourn, 2003) find reputation to have a positive link with earnings quality. Indeed, Francis et al. (2008) find that firms with low earnings quality are more likely to hire new CEOs with a better reputation than the preceding one and that, after hiring a reputable CEO, those firms do not manipulate earnings in the long term. The findings of Francis et al. (2008) suggest that reputable CEOs help to improve earnings quality, because earnings management practices in the hiring firms disappear.

This paper hypothesizes that reputable CEOs are more likely to be associated with high earnings quality, despite the mixed results discussed above, for the following reasons. The results obtained by Francis et al. (2008) are consistent with previous studies (e.g., Jian and Lee 2011) that also find reputable CEOs lead to high-quality

[3] Although some papers (Klein 2002; Bédard et al. 2004; Badolato et al. 2014) refer to membership of an audit committee as an indicator of financial expertise, the PSCORE does not include this indicator, to avoid overidentification. Most corporate governance codes require an audit committee to have at least one member with a financial background (FRC, 2003; FRC, 2012). Therefore, any member of an audit committee is likely to have a finance-related certification or finance-related work experience. These characteristics have already been captured by the other three financial expertise factors in the PSCORE.

organizational outcomes, the explanation being that they would have more to lose (compensation, future career, etc.) if they were involved with activities that were harmful to the organizations they worked for. The few studies that find an inverse relationship use selective and purposeful samples. For example, Malmendier and Tate (2009) use a sample of award-winning CEOs, and Wade et al. (2006) use a sample of those who have been selected as CEOs of the year. The uniqueness of these purposive samples limits the generalizability of the findings.

Based on the greater volume of prior research (Milbourn 2003; Francis et al. 2008; Jian and Lee 2011) suggesting a positive relationship between CEO reputation and earnings quality, the next three individual factors of the PSCORE are proxies for reputation, including performance during the last three years of the CEO's tenure (*pROA*), whether the CEO is still early on in their position at the firm (*pEARLY*), and press coverage (*pPRESS*). Details of the variable calculations are presented as an appendix. The rationale for the latter's inclusion is that reputable CEOs with good firm performance, longer tenures, and performance acknowledged by the board of directors would have caught the eye of the media (Milbourn 2003). The inclusion of the measure capturing whether the CEO is still relatively new to their position at the firm is consistent with empirical evidence indicating that earnings quality tends to be low in CEOs' first three years at a firm because they have incentives to manipulate earnings to demonstrate their ability when the market's perception of them is still uncertain (Ali and Zhang 2015).

2.3 Internal power

The next set of individual factors of the PSCORE are related to the internal power of CEOs in the firms. In most companies, CEOs are more powerful if they serve as the chairperson of the board of directors or if they are the founder of the firm. As corporate governance codes place strong accountabilities on the position of chairperson, they will play a very important role in overseeing activities such as monitoring the integrity of the financial reporting process (e.g., FRC, 2003, 2012). Founders, by virtue of their position, would be expected to participate in all the important business and financial policies of the company. Empirical evidence shows that powerful CEOs are more likely to engage in earnings management and accounting fraud (Dechow et al. 1996; Farber 2005; Feng et al. 2011). For example, Feng et al. (2011) provide evidence suggesting that powerful CEOs may dominate the firm's board of directors as well as the chief financial officer, thereby overriding internal control systems. In such situations, the chief financial officer could come under pressure from the CEO and thus collude to manipulate earnings.

Based on the above research, the next two individual factors account for CEOs serving as the chairperson of the board of directors (*pCHAIRMAN*) and CEOs who are also the founder or co-founder of the firm (*pFOUNDER*). Details of the variable calculations are presented as an appendix. In this paper, we expect powerful CEOs to be more likely to be associated with low earnings quality.

2.4 Age

The last individual factor of the PSCORE is the age of the CEO. There are indications in the existing literature about the effect of CEO age on earnings quality. Huang et al. (2012), Yim (2013), and Serfling (2014) find that older CEOs are less likely to manage earnings. The research also considers the horizontal problem of CEOs' tenure (e.g., Dechow and Sloan 1991; Kalyta 2009; Ali and Zhang 2015), which suggests that CEOs are more likely to manipulate earnings when they are young, or their age is close to retirement age. Thus, the next factor of the PSCORE is the age of the CEO (*pAGE*), which takes into account both young CEOs and and close to retirement CEOs at the same time. Details of the variable calculations are presented as an appendix.

2.5 Other potential factors

In addition to the above-mentioned CEO characteristics, there might be some other candidates for the construction of the PSCORE. For example, gender could be a factor because female directors are found to be more conservative, and therefore may be less likely to manipulate earnings (Barua et al. 2010). Marital status could also be relevant, as Hilary et al. (2016) provide evidence that firms with married CEOs exhibit higher earnings quality than firms whose CEOs are single, the explanation being that married CEOs are more risk-averse and less likely to engage in earnings management. Jia et al. (2014) find that facial masculinity is positively correlated with various measures of earnings quality. They argue that the hormone testosterone, which determines face shape, is also related to risk-taking behaviour such as involvement in financial misreporting activities. Narcissistic CEOs are more likely to manipulate earnings, a behaviour consistent with their tendency for self-overidentification (Capalbo et al. 2018). There are other CEO characteristics which may also be linked with earnings quality, e.g. overconfidence (Ahmed and Duellman 2013), management style (Bertrand and Schoar 2003), managerial ability (Demerjian et al. 2013), vocal tone optimism (Davis et al. 2015), origin (Kuang et al. 2014), and personal life behaviours such as having a legal record or using luxury goods (Davidson et al. 2015).

The PSCORE does not include the potential candidates mentioned above for the following reasons. Firstly, the PSCORE already has a variable for age, which is an observable summary statistic that can be used to characterize different personality traits of CEOs, such as effort, risk aversion, expected tenure, and human capital (Joos et al. 2003). Secondly, only 81 out of the 3,395 firm-year observations (2.39%) have female CEOs. Given the lack of gender diversity among the CEOs, we did not include gender in the PSCORE. Thirdly, it was not possible to obtain data on marital status, masculinity, or narcissism in the public domain for all CEOs in the sample, and therefore including those factors in the PSCORE would have substantially reduced the sample and its usability for analysis.

2.6 The composite PSCORE

We believed that the construction of a single measure for CEO characteristics would help to mitigate concerns about potential multicollinearity as a result of individual factors being separately included (see, e.g., Larcker et al. 2007; Dey 2008; Ellul and Yerramilli 2013; Custódio and Metzger 2014). As explained above, we have constructed nine indicator variables taking the value of either 1 or 0. The PSCORE is, therefore, a composite score which aggregates the nine indicator variables. The PSCORE of a CEO who works for firm *i* in year *t* is calculated as follows:

$$PSCORE_{i,t} = pCFO_{i,t} + pCERT_{i,t} + pROLE_{i,t} + pPRESS_{i,t} + pROA_{i,t} + pEARLY_{i,t} + pFOUNDER_{i,t} + pCHAIRMAN_{i,t} + pAGE_{i,t} \qquad (1)$$

Under this construction, the PSCORE value theoretically ranges from zero to nine. A higher PSCORE suggests lower earnings quality. We also perform principal component analysis to see whether the construction of the PSCORE based on nine equally weighted factors is defensible.

Because the main purpose of the study was to introduce a tool which could easily be applied by the average practitioner to quickly assess the risk of low earnings quality in individual firms, we limited the PSCORE to include CEO characteristics from publicly available data, e.g. data that could be collected from CEOs' curriculum vitae or financial statements. We are satisfied that the PSCORE does cover some significant categories established by previous research on CEO profiles, which serves the situation well. The hypothesis is as follows:

Hypothesis 1: The PSCORE is positively associated with low earnings quality.

3 Methodology

3.1 Sample selection

We begin with all firms listed on the London Stock Exchange from 2005 to 2012. The sample starts from 2005 to avoid the effect of IFRS adoption (2005) in the UK on earnings quality, and it ends in 2012 to avoid the effect of the new corporate governance code released by the Financial Reporting Council (Financial Reporting Council (FRC) 2012), which replaced the Corporate Governance Code that was issued in 1992 by the Cadbury Committee. The sample includes only those stocks that were live as of 31st December 2012. While survivorship bias may exist, we omit dead stocks because our research requires extensive data on CEOs and corporate governance which may not be available for delisted firms. Financial statements and International Securities Identification Number (ISIN hereafter) are downloaded from Datastream. We exclude banks, insurance companies, financial services, and utility firms. Companies with negative market values or negative book values of equity are also deleted.

To calculate deviations of first digits of figures reported in financial statements from Benford's Law, a measure of earnings quality, we firstly replace missing values with zeros.[4] Because the research studies the first digits from one to nine, replacing missing values with zeros does not affect our analysis. The next step is to extract the first digits of all items in the balance sheets, income statements, and cash flow statements. Similar to Amiram et al. (2015), this research takes the first digit after the negative sign if a number is negative, and takes the first non-zero digit if a number has an absolute value less than one. The total number of first digits for each company in each year is counted. Finally, we exclude observations with fewer than 50 first digits (or 50 figures in their financial statements) in total, to avoid measurement errors, because those firms might be too young or not have continuing operations, therefore including them might reduce the statistical meaning of the findings (Amiram et al. 2015).[5] As a result, we derive 5,110 firm-year observations from 2005 to 2012 (717 unique companies) with 389,619 first digits. This sample is used to calculate the deviations from Benford's Law for the firm-year observations.

[4] This approach does not apply to the calculation of the other variables.

[5] As a robustness test (not tabulated), we include observations with fewer than 50 first digits and the findings do not change qualitatively.

In the next step, we construct the CEO data. In the first stage, we use the ISIN codes to search for the company in the Bloomberg database; then, we identify the CEO for each company and year. When we cannot find the name of the CEO in a particular year in Bloomberg, we download the annual report from Key Note and look under the role description section or at signatures (with role descriptions) on CEO reports and financial statements, as the managing director or executive chairperson could play the role of CEO. If there is an appointment of a new CEO in a particular year, we choose the new CEO because we believe that the latest CEO will be the person with the greater influence on the financial statements prepared after year-end. Companies with missing or joint CEOs are deleted. In the second stage, we search for the biographies of the CEOs in Bloomberg. If Bloomberg does not provide a biography for a CEO, we search the Key Note platform using the CEO's name and ISIN code. If there is still no biography found from the above procedures, we read the annual reports downloaded from Key Note to search for CEO information in the role description section. We also search in the Financial Times and LinkedIn for missing biographies. Finally, if we cannot find sufficient information for the calculation of the PSCORE, we delete the corresponding observation.

Regarding the data on media coverage, we perform the following procedure. We search in the LexisNexis using the CEO's full name and company name as the keywords. If there is no result, we search for the first name and last name (omitting the middle name). In the LexisNexis database, we tick the options to eliminate duplicates, exclude non-business news, and restrict research results to UK national newspapers.[6] We count the total number of newspapers found in the search results. Although the above procedure for measuring press coverage is controversial, we believe that our measure captures the reputation of a CEO reasonably well. Firstly, although Lafond (2008) doubts whether all news is good news for the reputation of CEOs, Milbourn (2003), Francis et al. (2008), and Jian and Lee (2011) show that, overall, the total number of newspapers gives a fair representation of CEO reputation. Secondly, while prior studies have opened the search results to worldwide newspapers (for example, Francis et al. 2008), we argue that, if a global newspaper has headlines about the CEO of a UK listed

[6] UK national newspapers which are included in the research results in the LexisNexis database are the Daily Star, Daily Star Sunday, Express Online, Independent Print Ltd, MailOnline, Morning Star, The Business, The Daily Mail and Mail on Sunday (London), The Daily Telegraph (London), Telegraph (London), telegraph.co.uk, The Express, The Guardian, The Independent (United Kingdom), The Mirror (The Daily Mirror and The Sunday Mirror), mirror.co.uk, The Observer, The People, The Sunday, The Sunday Times (London), and The Times (London).

company, that news is also likely to be published in UK national newspapers. Therefore, expanding the research results to the global press may include duplicates.

To collect data on corporate governance, for the control variables, we proceed as follows. The information on external auditors, boards of directors, and audit committees is collected from Bloomberg. Missing information is obtained from Key Note. We also search for compensation and other information in the annual reports. Observations with missing data are removed.

Finally, we match the financial statement data, CEO data, and corporate governance data, based on the ISIN code and fiscal year. We derive 3,395 firm-year observations (615 unique companies) in 48 industries (Datastream Level 6) with sufficient data for us to study the PSCORE and discretionary accruals. The subsample in which we can study the PSCORE and the deviations of first digits of financial statement items from those are expected by Benford's Law contains 2,810 firm-year observations.[7] All continuous variables in the samples are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers.

3.2 Empirical measures of earnings quality

We have two types of proxies for earnings quality, which are discretionary accruals and financial statement errors.

3.2.1 Discretionary accruals

Prior research (Dechow et al. 2010; DeFond 2010) indicates that the use of discretionary accruals as a proxy for earnings quality is an accepted methodology in accounting. Higher levels of discretionary accruals suggest lower earnings quality. In the UK, Peasnell et al. (2000) show that no model outperforms the modified-Jones model (Jones 1991; Dechow et al. 1995) in estimating discretionary accruals. Therefore, we employ the cross-sectional modified-Jones model to estimate discretionary accruals, where accruals are total or working capital accruals (used as substitutes).

We run the cross-sectional modified-Jones model (Jones 1991; Dechow et al. 1995) for each industry-year with at least ten observations, and calculate the absolute values of discretionary accruals (*DAC*) and discretionary working capital accruals (*DWAC*). *DAC* and *DWAC* are thus the first two proxies for earnings

[7] The subsample is smaller than the main sample because firms with fewer than 50 first digits are excluded.

quality. We use the absolute values of the discretionary accruals because we design the PSCORE to signal earnings quality without a particular emphasis on the directional effects of accruals on earnings.[8] The reason is that the residuals from the accrual-based models reflect the amount of earnings being transferred from one year to another, thus both income-inflating and income-deflating accruals are more likely to result in low earnings quality, regardless of the directional effects of the amount of earnings transferred (Bergstresser and Philippon 2006).

We also apply the margin model of Peasnell et al. (2000) to estimate discretionary working capital accruals because the margin model is found to be effective in estimating discretionary accruals in the UK. We run cross-sectional regressions following Peasnell et al. (2000) for each industry-year with at least ten observations and calculate the absolute values of the errors terms, denoting them by *DAMP*. *DAMP* is thus the next proxy for earnings quality.

Although the models mentioned above are widely applied in accounting research, they are criticized due to their major limitations (e.g., Fields et al. 2001; Dechow et al. 2010; Gerakos 2012; Ball 2013; Owens et al. 2013; Christodoulou et al. 2018; Jackson 2018; McNichols and Stubben 2018). Therefore, we employ an alternative measure of earnings quality that relies on Benford's Law and is calculated from firm-year data alone.

3.2.2 Financial statement errors

The use of Benford's Law to identify errors in data is common in accounting research (see, e.g., Carslaw 1988; Thomas 1989; Nigrini 1996; Nigrini and Mittermaier 1997; Nigrini and Miller 2009; Amiram et al. 2015). For example, Carslaw (1988) studies the second digits of reported income in the financial statements of New Zealand firms and finds that the actual frequencies of zeros (nines) are more (less) than expected by Benford's Law. He interprets this phenomenon as being caused by the rounding-up behaviour of managers, to achieve earnings targets. Consistent with Carslaw (1988), Thomas (1989) shows similar patterns in the US, but with less deviation of earnings numbers from the expectations derived from Benford's Law.

Recently, Amiram et al. (2015) have introduced a new way of applying Benford's Law to signal financial statement errors using firm-year data. They develop an innovative score, namely the FSD_SCORE, to capture the deviations of the first digits of figures reported in financial statements, from Benford's Law. The FSD_SCORE is

[8] Prior studies using the absolute values of discretionary accruals include Bergstresser and Philippon (2006), Jiang et al. (2010), Armstrong et al. (2010), and Hilary et al. (2016), to name just a few.

also found to be correlated with earnings management and is helpful for predicting material accounting misstatements. Compared with other proxies for earnings quality, the FSD_SCORE has some significant advantages, such as not requiring a model for its estimation and the unlikeliness of there being an *ex-ante* relationship between the FSD_SCORE and firm characteristics and performance (Amiram et al. 2015).

In this paper, we closely follow Amiram et al. (2015) and Nguyen et al. (2018) to calculate the FSD_SCORE, which is the *mean absolute deviation* of the first digits of figures reported in financial statements from what is expected based on Benford's Law. When financial statements are free of errors, the FSD_SCORE equals zero because then the financial statements follow Benford's Law (Amiram et al. 2015). An introduction of errors (which may result from intentional or unintentional acts) into the financial statements increases the deviations of the first digits, therefore the FSD_SCORE can be used as a proxy for earnings quality. The last measure of earnings quality is KS statistic, which is the *maximum deviation* of digits from Benford's Law, where the deviation is defined as the *cumulative absolute difference* between the observed and expected probabilities of each digit (Amiram et al. 2015). In general, a higher FSD_SCORE or KS will suggest lower earnings quality.

3.3 Multivariate regression models

To test the hypothesis, we use two sets of multivariate regression models. The first set of models, used to study discretionary accruals and the PSCORE, is as follows:

$$EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 aBDIND_{i,t} + \beta_6 aACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 aLOGMVE_{i,t-1} + \beta_{10} aLOGMTB_{i,t-1} + 11 aLEV_{i,t-1} + \beta_{12} aNOA_{i,t-1} + \varepsilon, \qquad (2)$$

where $EM_{i,t}$ is the absolute value of discretionary total accruals ($DAC_{i,t}$) or discretionary working capital accruals ($DWAC_{i,t}$), both estimated by the modified-Jones models (Jones 1991; Dechow et al. 1995), or discretionary working capital accruals ($DAMP_{i,t}$) estimated by the margin model (Peasnell et al. 2000). These three different measures of discretionary accruals are used as substitutes for one another in the regressions.

Following prior research (e.g., Peasnell et al. 2005; Lee et al. 2006; Botsari and Meeks 2008; Chi and Gupta 2009; García Lara et al. 2009; Iqbal et al. 2009; Iqbal and Strong 2010; Baber et al. 2011), we control for some important determinants of earnings quality, including seasoned equity offerings ($SEO_{i,t}$), share-financed mergers and acquisitions ($M\&A_{i,t}$), Big Four auditor ($AUDIT_{i,t}$), industry-adjusted board independence ($aBDIND_{i,t}$), industry-adjusted independence of audit committee ($aACIND_{i,t}$), the business life cycle ($CYCLE_{i,t}$), financial distress ($DISTRESS_{i,t-1}$), industry-adjusted firm size ($aLOGMVE_{i,t-1}$), industry-adjusted market-to-book ratio ($aLOGMTB_{i,t-1}$), industry-adjusted financial leverage ($aLEV_{i,t-1}$), and industry-adjusted net operating asset ratio ($aNOA_{i,t-1}$). Detailed calculations of the control variables can be found in the appendix.

Secondly, to test the relationship between the PSCORE and financial statement errors, we use the following regression:

$$ERROR_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 BDIND_{i,t} + \beta_6 ACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 LOGMVE_{i,t-1} + \beta_{10} LOGMTB_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} NOA_{i,t-1} + YEAR/INDUSTRY\ FIXED\ EFFECTS + \varepsilon \quad (3)$$

where $ERROR_{i,t}$ is either $FSD\_SCORE_{i,t}$ or $KS_{i,t}$ (used as substitutes). As we include fixed effects in model (3), we use firm-level variables of board independence ($BDIND_{i,t}$), audit committee independence ($ACIND_{i,t}$), firm size ($LOGMVE_{i,t-1}$), the market to book ratio ($LOGMTB_{i,t-1}$), financial leverage ($LEV_{i,t-1}$), and the net operating asset ratio ($NOA_{i,t-1}$) in the regression.

If the coefficients β_1 in the above regressions are positive and significant, this will be evidence in support of Hypothesis 1, showing that the PSCORE is positively associated with the proxies for low earnings quality.

4 Findings

4.1 Descriptive statistics and correlations

Table 1 reports the descriptive statistics of firm characteristics, the individual factors of the PSCORE, the proxies for earnings quality, and the control variables used in the main regressions. At first glance, the numbers of observations for the FSD_SCORE and KS are smaller than for the discretionary accruals because, as discussed previously, FSD_SCORE and KS require firms to have more than 50 items (or first digits) reported in their financial statements. Looking at Panel A, the descriptive statistics for the firm characteristics in the main sample are broadly similar to those reported by Goh and Gupta (2016), who use similar data. The descriptive statistics on the individual factors of the PSCORE, reported in Panel B, show that, on average, CEOs have low financial expertise (medians of all proxies for financial expertise are 1) and high reputations (medians of *pPRESS*, *pROA,* and *pEARLY* are 1, 0, and 0, respectively). The statistics also indicate that a minority of CEOs are chairpersons or founders of firms (medians of *pCHAIRMAN* and *pFOUNDER* are 0). Turning to Panel C, we observe that the values of *DAC* are the highest in all aspects (mean, standard deviation, median, 25th and 75th percentiles), and

Table 1 Descriptive Statistics

Statistics	N	MIN	MAX	MEAN	STD	MEDIAN	P25	P75
Panel A: Firm characteristics								
Total assets$_{i,t}$ (£'000)	3395	1,392	28,411,781	990,192	3,623,169	79,632	18,599	419,650
Sales$_{i,t}$ (£'000)	3395	17	18,057,594	792,155	2,393,480	78,888	14,404	421,338
Net income before extraordiany items$_{i,t}$ (£'000)	3395	-84,000	2,875,916	66,335	327,540	2,535	-479	22,022
Market values$_{i,t}$ (£'000)	3395	1,222	40,444,127	1,065,417	4,692,480	62,107	15,566	389,453
Market to book ratio$_{i,t}$	3395	0.1815	21.7704	2.8619	3.3567	1.7818	1.0306	3.2930
Leverage$_{i,t}$	3395	0	0.5929	0.1483	0.1492	0.1148	0.0051	0.2407
Panel B: Individual factors of PSCORE								
pCFO$_{i,t}$	3395	0	1	0.8251	0.3799	1	1	1
pCERT$_{i,t}$	3395	0	1	0.6393	0.4803	1	0	1
pROLE$_{i,t}$	3395	0	1	0.5339	0.4989	1	0	1
pPRESS$_{i,t}$	3395	0	1	0.7697	0.4211	1	1	1
pROA$_{i,t}$	3395	0	1	0.1820	0.3859	0	0	0
pEARLY$_{i,t}$	3395	0	1	0.2488	0.4324	0	0	0
pFOUNDER$_{i,t}$	3395	0	1	0.1628	0.3693	0	0	0
pCHAIRMAN$_{i,t}$	3395	0	1	0.1007	0.3010	0	0	0
pAGE$_{i,t}$	3395	0	1	0.3442	0.4752	0	0	1
Panel C: Earnings quality proxies								
DAC$_{i,t}$	3395	0.0010	0.5185	0.0782	0.0877	0.0503	0.0241	0.0991
DWAC$_{i,t}$	3395	0.0007	0.3986	0.0617	0.0703	0.0388	0.0171	0.0786
DAMP$_{i,t}$	3395	0.0006	0.3827	0.0579	0.0658	0.0371	0.0167	0.0751
FSD_SCORE$_{i,t}$	3197	0.0132	0.0623	0.0318	0.0097	0.0309	0.0249	0.0374
KS$_{i,t}$	3197	0.0272	0.2147	0.0894	0.0387	0.0817	0.0610	0.1114

Table 1 (continued)

Statistics	N	MIN	MAX	MEAN	STD	MEDIAN	P25	P75
Panel D: Independent variables of main regressions								
$PSCORE_{i,t}$	3395	0	8	3.8065	1.5009	4	3	5
$SEO_{i,t}$	3395	0	1	0.2153	0.4111	0	0	0
$M\&A_{i,t}$	3395	0	1	0.0418	0.2002	0	0	0
$AUDIT_{i,t}$	3395	0	1	0.5642	0.4959	1	0	1
$aBDIND_{i,t}$	3395	-0.4200	0.4370	0.0154	0.2153	0.0422	-0.1477	0.1752
$aACIND_{i,t}$	3395	-0.5000	0.9091	0.0100	0.2739	0.0000	-0.0909	0.0000
$CYCLE_{i,t}$	3395	0	1	0.0259	0.1589	0	0	0
$DISTRESS_{i,t-1}$	3395	0	1	0.2741	0.4461	0	0	1
$aLOGMVE_{i,t-1}$	3395	-3.7015	5.9248	0.2022	1.9650	0.0423	-1.2163	1.3871
$aLOGMTB_{i,t-1}$	3395	-1.9314	2.4059	-0.0365	0.8207	-0.0530	-0.5730	0.4558
$aLEV_{i,t-1}$	3395	-0.6185	0.3844	-0.0272	0.1568	-0.0472	-0.1205	0.0709
$aNOA_{i,t-1}$	3395	-113.0504	61.4047	-2.3055	16.7590	-0.1371	-0.5842	0.2959

Note: Panels A, B, C, and D report the number of observations (N), minimum (MIN), maximum (MAX), mean (MEAN), standard deviation (STD), median (MEDIAN), and 25th (P25) and 75th (P75) percentiles of firm characteristics, individual factors of the PSCORE, proxies for earnings quality, and variables of the main regressions. Definitions of variables are provided in the appendix.

Table 2 Pearson Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
$DAC_{i,t}$	1	1.00																
$DWAC_{i,t}$	2	0.48*	1.00															
$DAMP_{i,t}$	3	0.37*	0.73*	1.00														
$FSD\_SCORE_{i,t}$	4	0.11*	0.09*	0.07*	1.00													
$KS_{i,t}$	5	0.07*	0.06*	0.05*	0.74*	1.00												
$PSCORE_{i,t}$	6	0.15*	0.14*	0.15*	0.17*	0.15*	1.00											
$SEO_{i,t}$	7	0.18*	0.18*	0.16*	0.08*	0.06*	0.14*	1.00										
$M\&A_{i,t}$	8	0.06*	0.13*	0.13*	-0.02	-0.01	0.02	0.20*	1.00									
$AUDIT_{i,t}$	9	-0.18*	-0.15*	-0.15*	-0.20*	-0.18*	-0.25*	-0.13*	-0.01	1.00								
$aBDIND_{i,t}$	10	-0.10*	-0.10*	-0.10*	-0.15*	-0.12*	-0.25*	-0.11*	0.01	0.37*	1.00							
$aACIND_{i,t}$	11	-0.08*	-0.07*	-0.08*	-0.11*	-0.10*	-0.20*	-0.08*	-0.02	0.25*	0.34*	1.00						
$CYCLE_{i,t}$	12	0.08*	0.08*	0.05*	0.02	0.02	0.06*	0.06*	0.04	-0.06*	-0.03	-0.05*	1.00					
$DISTRESS_{i,t-1}$	13	0.12*	0.07*	0.05*	0.13*	0.10*	0.16*	0.24*	-0.00	-0.10*	-0.15*	-0.11*	0.11*	1.00				
$aLOGMVE_{i,t-1}$	14	-0.14*	-0.15*	-0.14*	-0.24*	-0.18*	-0.34*	-0.19*	-0.02	0.46*	0.59*	0.47*	-0.11*	-0.25*	1.00			
$aLOGMTB_{i,t-1}$	15	0.07*	0.12*	0.12*	0.04	0.03	-0.01	-0.01	0.01	0.06*	0.10*	0.17*	-0.03	-0.00	0.35*	1.00		
$aLEV_{i,t-1}$	16	-0.11*	-0.11*	-0.11*	-0.13*	-0.10*	-0.13*	0.03	-0.02	0.17*	0.10*	0.12*	-0.04	0.04	0.20*	0.01	1.00	
$aNOA_{i,t-1}$	17	-0.00	-0.02	0.01	0.01	-0.01	0.03	0.01	-0.00	-0.05*	-0.10*	-0.08*	0.00	0.02	-0.14*	-0.01	-0.04	1.00

Note: This table reports the Pearson correlation coefficients between selected variables. * shows significance at the 1% level. Definitions of variables are provided in the appendix.

the values of *DAMP* are the lowest. Previous studies support these findings, since Botsari and Meeks (2008) find that using total accruals has a tendency to result in larger discretionary accruals than using working capital accruals, and Peasnell et al. (2000) provide evidence that the Jones and modified-Jones models produce higher discretionary accruals than the margin model when cash flows are unusually high. We also observe that the mean and standard deviation of the FSD_SCORE for listed companies in the UK from 2005 to 2012 are 0.0324 and 0.0098 respectively. These are similar figures to those for listed companies in the US reported by Amiram et al. (2015).[9] In Panel D, the mean and median of the PSCORE are 3.8065 and 4 respectively, suggesting that the difference between the PSCOREs of those firms with high PSCORES and those with low PSCORES is not large, given that the PSCORE empirically ranges from zero to eight.[10] Panel D also displays that the sample has more firms without equity issuance than with equity issuance (all medians of *SEO* and *M&A* are 0), has more firms audited by Big Four than not (median of *AUDIT* is 1), has more firms not facing financial distress than firms facing financial distress (median of *DISTRESS* is 0), and has more mature firms than young or growth firms (median of *CYCLE* is 0).

Table 2, which reports Pearson correlations, indicates that all correlations between the PSCORE and the proxies for earnings quality are positive and significant at the 1% level, suggesting positive relationships between the PSCORE and earnings quality. While there are many insignificant correlations among the independent variables, we still test for multicollinearity between the independent variables using variance inflation factors (VIFs) obtained from the ordinary least squares regressions. The results (not tabulated) indicate that all VIFs are less than 2.47, which is well below 10, the level indicative of multicollinearity as suggested by Neter et al. (1996).

4.2 Principal component analysis

We employ principal component analysis to look at whether our methodology for constructing the PSCORE is defensible. In Table 3, Panel A shows that most correlation coefficients are very small (absolute values are less than 0.15), except for those between *pCERT* and *pCFO* (0.4822) and between *pEARLY* and *pROLE* (0.5159). Many correlations are statistically insignificant. The findings indicate that auto-correlation among individual factors is not a concern in constructing the PSCORE. Panel B shows that CEO characteristics have

[9] Amiram et al. (2015) report mean and standard deviation of the FSD_SCOREs of listed companies in the US from 2001 to 2011 to be 0.0296 and 0.0087, respectively.

[10] While the PSCORE theoretically varies from zero to nine, there is no CEO with a PSCORE of nine in the sample.

multiple dimensions, as the first component can explain only 17.86% of the variance in the original data and the cumulative variance explained by the fourth component is 58.04%. In Panel C, we observe that no individual factor has too high a loading.

In summary, the principal component analysis suggests that no individual factor dominates the other factors in explaining the variance of the PSCORE. Therefore, the PSCORE can be used as a single measure of CEO characteristics with multiple dimensions.

4.3 Univariate tests

The univariate tests study how the earnings quality variables change when the PSCORE changes. It can be seen in Table 4 that the mean values of the earnings quality proxies increase monotonically when the PSCORE increases. Additionally, the last four rows of Table 4 report the results of the t-test under the null that the means of the earnings quality proxies for the high-PSCORE group (PSCORE equals 6, 7, or 8) are the same as those of the low-PSCORE group (PSCORE equals 0, 1, or 2). The findings demonstrate that, compared to the low-PSCORE group, the high-PSCORE group exhibits higher levels of discretionary accruals and higher deviations of first digits from Benford's Law. The mean differences in earnings quality between the two groups are statistically significant at the 1% level. [11] In general, the findings from the univariate tests provide preliminary evidence supporting Hypothesis 1, that the PSCORE is positively associated with low earnings quality.

[11] As a robustness test (not tabulated), we define PSCORE groups in another way, with the low-PSCORE group including PSCOREs ranging from 0 to 4 and the high-PSCORE group those from 5 to 8. The findings do not change qualitatively.

Table 3 Principal Component Analysis

Panel A: Correlation matrix of individual factors of PSCORE

	$pCFO_{i,t}$	$pCERT_{i,t}$	$pROLE_{i,t}$	$pPRESS_{i,t}$	$pROA_{i,t}$	$pEARLY_{i,t}$	$pFOUNDER_{i,t}$	$pCHAIRMAN_{i,t}$	$pAGE_{i,t}$
$pCFO_{i,t}$	1								
$pCERT_{i,t}$	0.4822	1							
$pROLE_{i,t}$	-0.0449	*0.0012*	1						
$pPRESS_{i,t}$	0.0335	0.0596	*0.0189*	1					
$pROA_{i,t}$	0.0243	0.0507	0.0919	0.0404	1				
$pEARLY_{i,t}$	0.0678	*0.0224*	0.5159	*0.0187*	0.1116	1			
$pFOUNDER_{i,t}$	0.0918	0.0905	-0.1426	-0.0391	0.0318	-0.0730	1		
$pCHAIRMAN_{i,t}$	0.0433	0.0333	-0.0463	0.0366	*0.0045*	*-0.0115*	0.0777	1	
$pAGE_{i,t}$	*-0.0025*	*-0.0185*	0.0869	0.0312	*0.0117*	0.0489	0.0380	*-0.0118*	1

Panel B: Eigenvalues of the correlation matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	1.6077	0.0634	0.1786	0.1786
2	1.5443	0.4907	0.1716	0.3502
3	1.0537	0.0357	0.1171	0.4673
4	1.0180	0.0240	0.1131	0.5804
5	0.9940	0.0301	0.1104	0.6909
6	0.9640	0.1356	0.1071	0.7980
7	0.8284	0.2829	0.0920	0.8900
8	0.5455	0.1010	0.0606	0.9506
9	0.4445		0.0494	1.0000

Table 3 (continued)

Panel C: Eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8	Prin9
$pCFO_{i,t}$	-0.0011	0.6662	-0.1929	-0.0468	0.0852	0.0672	-0.1056	-0.5705	0.4104
$pCERT_{i,t}$	0.0061	0.6660	-0.1946	0.0046	0.0731	-0.0011	-0.0903	0.6172	-0.3523
$pROLE_{i,t}$	0.6674	-0.0309	-0.0104	-0.0730	-0.0396	0.1430	0.1291	0.3894	0.5982
$pPRESS_{i,t}$	0.0724	0.1169	0.1951	0.8550	0.2369	-0.1135	0.3763	-0.0350	0.0173
$pROA_{i,t}$	0.2156	0.1259	0.3403	0.0285	-0.3359	-0.7664	-0.3454	-0.0268	0.0284
$pEARLY_{i,t}$	0.6494	0.0757	0.0150	-0.1098	-0.1281	0.1497	0.2117	-0.3692	-0.5834
$pFOUNDER_{i,t}$	-0.2298	0.2396	0.5048	-0.4153	-0.0628	-0.0884	0.6661	0.0494	0.0680
$pCHAIRMAN_{i,t}$	-0.0891	0.1379	0.5101	0.2182	-0.4843	0.5806	-0.3035	0.0337	0.0147
$pAGE_{i,t}$	0.1427	-0.0007	0.5056	-0.1689	0.7496	0.0858	-0.3502	-0.0129	-0.0579

Note: This table reports the results of the principal component analysis. Panel A reports the correlations between individual factors. The values reported in italics indicate that the corresponding coefficients are not significant at the 5% level. Panel B (C) reports the eigenvalues (vectors) of the correlation matrix resulting from the principal component analyses on the nine individual components of the PSCORE. Definitions of variables are provided in the appendix.

Table 4 Earnings Quality per PSCORE Group

$PSCORE_{i,t}$	N	$DAC_{i,t}$	$DWAC_{i,t}$	$DAMP_{i,t}$	$FSD\_SCORE_{i,t}$	$KS_{i,t}$
0	38	0.036	0.029	0.028	0.029	0.080
1	156	0.059	0.057	0.044	0.029	0.077
2	443	0.061	0.052	0.048	0.030	0.086
3	832	0.073	0.056	0.054	0.031	0.085
4	827	0.078	0.057	0.052	0.032	0.088
5	662	0.085	0.069	0.069	0.033	0.093
6	307	0.095	0.077	0.073	0.035	0.101
7	116	0.111	0.088	0.089	0.036	0.103
8	14	0.164	0.128	0.084	0.036	0.112
High (PSCORE=6,7,8)	437	0.102	0.082	0.077	0.035	0.102
Low (PSCORE=0,1,2)	637	0.059	0.052	0.046	0.030	0.084
Difference		0.043	0.030	0.032	0.006	0.018
t-statistics		7.581***	7.084***	5.977***	7.19***	3.058***

Note: This table reports the means by PSCORE for each measure of earnings quality. The last four rows of the table show the means of the high-PSCORE and low-PSCORE groups, the mean differences between the two groups, and t-statistics obtained from t-tests under the null that the difference is zero.

Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

4.4 Multivariate regression results

This section reports the findings of the main regressions. Table 5 presents the results of the set of regressions described in equation (2). Consistent with the hypothesis, we find a positive coefficient on the PSCORE. The positive relationships are statistically significant in all models where the dependent variables are DAC (column a), DWAC (column b), or DAMP (column c). While the PSCORE coefficients are slightly different across the models, the qualitative effects are consistent. In terms of economic significance, the coefficient on DAC suggests that a one-unit increase in the PSCORE is associated with an increase of 0.0118 (= 0.309/100*3.8, given that 3.8 is the mean of the PSCORE, as reported in Table 1) in DAC, which accounts for 15% of its mean (15% = 0.012/0.0782, given that 0.0782 is the mean of DAC as reported in Table 1). Similarly, an increase in the PSCORE of one unit is associated with an increase of 0.0078 in DWAC (or 12.7% of its mean) and of 0.0019 in DAMP (or 20.5% of its mean). In general, the findings provide evidence that the PSCORE could act as a red flag regarding high levels of abnormal accruals or low earnings quality. The evidence supports Hypothesis 1.

Table 5 PSCORE and Discretionary Accruals

Variable	Expected sign	DAC (a)		DWAC (b)		DAMP (c)	
		Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
$PSCORE_{i,t}$	+	**0.309*** **	**2.95**	**0.206** **	**2.47**	**0.313*** **	**4.02**
$SEO_{i,t}$	+	3.134***	8.33	2.241***	7.47	1.86***	6.62
$M\&A_{i,t}$	+	1.276*	1.74	3.056***	5.22	3.004***	5.49
$AUDIT_{i,t}$	-	-2.132***	-6.34	-0.984***	-3.67	-1.018***	-4.06
$aBDIND_{i,t}$	-	-0.015	-0.01	-0.131	-0.18	0.294	0.47
$aACIND_{i,t}$	-	-0.22	-0.36	0.122	0.26	-0.1	-0.22
$CYCLE_{i,t}$	+	2.25**	2.46	2.147***	2.94	0.811	1.19
$DISTRESS_{i,t-1}$	+	0.936***	2.70	-0.036	-0.12	-0.361	-1.39
$aLOGMVE_{i,t-1}$	-	-0.212*	-1.83	-0.436***	-4.75	-0.43***	-5.01
$aLOGMTB_{i,t-1}$	+	0.927***	4.84	1.379***	9.04	1.355***	9.50
$aLEV_{i,t-1}$		-4.329***	-4.55	-3.381***	-4.46	-2.849***	-4.02
$aNOA_{i,t-1}$	-	-0.009	-1.00	-0.018***	-2.65	-0.009	-1.35
Constant		6.747***	13.93	5.289***	13.70	4.765***	13.19
Observations		3,395		3,395		3,395	
Adjusted R^2		0.093		0.103		0.103	

Note: This table reports the estimations of the following equation: $EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 aBDIND_{i,t} + \beta_6 aACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 aLOGMVE_{i,t-1} + \beta_{10} aLOGMTB_{i,t-1} + \beta_{11} aLEV_{i,t-1} + \beta_{12} aNOA_{i,t-1} + \varepsilon$, where $EM_{i,t}$ is $DAC_{i,t}$, $DWAC_{i,t}$ and $DAMP_{i,t}$ in columns (a), (b), and (c), respectively. All coefficients are multiplied by 100 for easy reading. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

Table 5 also indicates that the control variables have the predicted signs and most coefficients are consistently significant across the different models. As expected, the positive coefficients on SEO and $M\&A$ suggest that equity issuance increases earnings management or reduces earnings quality. Besides this, the coefficients on $AUDIT$, $aBDIND$, and $aACIND$ are negative, implying that strong corporate governance reduces earnings management or increases earnings quality. Also, while large firms are less likely to manipulate earnings, over-valued firms engage in more earnings management, evidenced by higher abnormal accruals.

Moving to financial statement errors, Table 6 reports the findings from the set of regressions described by equation (3). The results show that the coefficients on the PSCORE, when the dependent variable is FSD_SCORE (Panel A) and KS (Panel B) respectively, are positive and statistically significant in all four specifications. In terms of economic significance, for example, in column (d), where the model controls for industry and year fixed effects, a one-unit increase in the PSCORE is associated with an increase of 0.0012 in FSD_SCORE (or 3.7% of its mean) and an increase of 0.004 in KS (or 4.56% of its mean). In general, the results demonstrate that the PSCORE can capture deviations of first digits of figures reported in financial statements from what would be expected according to Benford's Law.

To summarize, the findings of the multivariate regressions indicate that the PSCORE is positively associated with the established proxies for earnings quality. The relationships are statistically and economically significant. The findings support Hypothesis 1 and suggest that the PSCORE could be a useful tool for red flagging low earnings quality in individual firms.

Table 6 PSCORE and Financial Statement Errors

	Expected sign	(a)		(b)		(c)		(d)	
		Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
Panel A: FSD_SCORE									
$PSCORE_{i,t}$	+	**0.034****	**2.81**	**0.035****	**2.92**	**0.030***	**2.52**	**0.031****	**2.59**
$SEO_{i,t}$	+	0.023	0.54	0.026	0.61	-0.019	-0.44	-0.015	-0.35
$M\&A_{i,t}$	+	-0.161*	-1.96	-0.149	-1.81	-0.148	-1.81	-0.138	-1.68
$AUDIT_{i,t}$	-	-0.119**	-3.04	-0.117**	-2.99	-0.087*	-2.17	-0.085*	-2.11
$aBDIND_{i,t}$	-	-0.098	-1.09	-0.095	-1.06	0.070	0.75	0.075	0.81
$aACIND_{i,t}$	-	0.027	0.48	-0.011	-0.18	0.035	0.62	0.005	0.08
$CYCLE_{i,t}$	+	-0.104	-1.01	-0.111	-1.07	-0.141	-1.38	-0.149	-1.45
$DISTRESS_{i,t-1}$	+	0.132***	3.39	0.131***	3.36	0.098*	2.43	0.098*	2.42
$aLOGMVE_{i,t-1}$	-	-0.093***	-8.01	-0.091***	-7.79	-0.129***	-9.68	-0.129***	-9.54
$aLOGMTB_{i,t-1}$	+	0.124***	6.71	0.129***	6.70	0.149***	7.49	0.153***	7.37
$aLEV_{i,t-1}$	?	-0.463***	-4.10	-0.445***	-3.93	-0.384**	-3.19	-0.369**	-3.06
$aNOA_{i,t-1}$	?	0.000**	2.61	0.000*	2.51	0.000*	2.38	0.000*	2.27
Constant		0.042***	31.76	0.041***	28.49	0.046***	26.62	0.046***	24.91
Year fixed effects		No		Yes		No		Yes	
Industry fixed effects		No		No		Yes		Yes	
Observations		3197		3197		3197		3197	
Adjusted R^2		0.1049		0.1052		0.1293		0.1297	
Panel B: KS									
$PSCORE_{i,t}$	+	**0.130****	**2.66**	**0.134****	**2.75**	**0.104***	**2.10**	**0.107***	**2.16**
$SEO_{i,t}$	+	-0.026	-0.15	-0.009	-0.05	-0.170	-0.95	-0.149	-0.83
$M\&A_{i,t}$	+	-0.342	-1.02	-0.299	-0.89	-0.302	-0.90	-0.265	-0.79

Table 6 (continued)

	Expected sign	(a)		(b)		(c)		(d)	
		Coefficient	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
$AUDIT_{i,t}$	-	-0.622***	-3.90	-0.600***	-3.76	-0.461**	-2.79	-0.438**	-2.65
$aBDIND_{i,t}$	-	-0.182	-0.50	-0.171	-0.47	0.317	0.83	0.342	0.90
$aACIND_{i,t}$	-	-0.031	-0.13	-0.169	-0.66	-0.026	-0.11	-0.120	-0.47
$CYCLE_{i,t}$	+	-0.211	-0.50	-0.258	-0.61	-0.284	-0.67	-0.333	-0.79
$DISTRESS_{i,t-1}$	+	0.455**	2.86	0.461**	2.89	0.370*	2.24	0.376*	2.27
$aLOGMVE_{i,t-1}$	-	-0.256***	-5.43	-0.252***	-5.29	-0.377***	-6.87	-0.379***	-6.84
$aLOGMTB_{i,t-1}$	+	0.395***	5.22	0.403***	5.13	0.477***	5.84	0.480***	5.65
$aLEV_{i,t-1}$	?	-1.563***	-3.39	-1.489**	-3.22	-1.296**	-2.62	-1.237*	-2.50
$aNOA_{i,t-1}$	?	0.000	0.95	0.000	0.80	0.000	0.67	0.000	0.52
Constant		0.116***	21.77	0.112***	19.08	0.127***	17.84	0.124***	16.42
Year fixed effects		No		Yes		No		Yes	
Industry fixed effects		No		No		Yes		Yes	
Observations		3197		3197		3197		3197	
Adjusted R^2		0.0682		0.0704		0.0837		0.0858	

Note: This table reports the estimations of the following equation:

$$ERROR_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 BDIND_{i,t} + \beta_6 ACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 LOGMVE_{i,t-1} + \beta_{10} LOGMTB_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} NOA_{i,t-1} + INDUSTRY/YEAR\ FIXED\ EFFECTS + \varepsilon,$$

where $ERROR_{i,t}$ is $FSD\_SCORE_{i,t}$ (Panel A) or $KS_{i,t}$ (Panel B). All coefficients are multiplied by 100 for easy reading. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

4.5 The role of CEOs' equity-based incentives

So far, this study has provided evidence that the PSCORE can signal the presence of poor earnings quality. This section studies the impact of the CEO's equity-based incentives on the relationship between the PSCORE and poor earnings quality.

Previous research indicates that CEOs' equity-based incentives negatively affect earnings quality (Cheng and Warfield 2005; Bergstresser and Philippon 2006; Chava and Purnanandam 2010; Jiang et al. 2010). For example, Bergstresser and Philippon (2006) find that firms exhibit abnormally high accruals when there is a strong association between the CEO's total compensation and changes in the firm's share price. Later studies support the idea that earnings quality is affected by the CEO's equity-based incentives (Cheng and Warfield 2005; Jiang et al. 2010). Therefore, it is reasonable to predict that, when CEOs have a high PSCORE and high equity-based incentives, i.e. their compensation and wealth are closely tied to reported earnings, they will have a higher tendency to manage earnings numbers. In general, we conjecture that the relationships between the PSCORE and the proxies for earnings quality will be stronger among firms whose CEOs have high equity-based incentives.

We follow prior studies to estimate CEOs' equity-based incentives (e.g., Bergstresser and Philippon 2006; Armstrong et al. 2010; Jiang et al. 2010; Feng et al. 2011; Armstrong et al. 2013) as follows:

$$INCENTIVE = \frac{ONEPCT}{(ONEPCT\ +\ SALARY\ +\ BONUS)}$$

$$ONEPCT = 0.01\ x\ PRICE\ x\ (SHARE + OPTION)$$

where $INCENTIVE$ is the equity-based incentives of the CEO in question, $ONEPCT$ is the change in the CEO's equity holdings corresponding to a 1% change in the stock price, $PRICE$ is the share price at the end of the fiscal year, $SHARE$ is the shares held by the CEO, $OPTION$ is the options held by the CEO, $SALARY$ is the total cash salary the CEO receives, and $BONUS$ is the cash bonus the CEO receives.

We then re-run equations (2) and (3) using the subsamples of firms whose CEOs have high and low equity-based incentives, where high (low) equity-based incentives are defined as *INCENTIVE* being greater than or equal to (lower than) the median across all firms.

Table 7A and Table 7B report the findings of the estimations of equations (2) and (3), respectively. The evidence shows that the coefficients on the PSCORE are higher in the subsample with high equity-based incentive

Table 7A Effect of Equity-based Incentives of CEOs on Relationship between PSCORE and Discretionary Accruals

	DAC		DWAC		DAMP	
	High Incentive	Low Incentive	High Incentive	Low Incentive	High Incentive	Low Incentive
	(1)	(2)	(3)	(4)	(5)	(6)
$PSCORE_{i,t}$	**0.384***	**0.172**	**0.182**	**0.158**	**0.354****	**0.185**
	(2.48)	**(1.25)**	**(1.46)**	**(1.46)**	**(3.00)**	**(1.85)**
$SEO_{i,t}$	3.348***	2.732***	2.765***	1.379***	2.421***	1.047**
	(6.25)	(5.27)	(6.42)	(3.38)	(5.94)	(2.78)
$M\&A_{i,t}$	1.678	0.329	2.193**	4.276***	2.680***	3.301***
	(1.68)	(0.30)	(2.74)	(5.04)	(3.53)	(4.21)
$AUDIT_{i,t}$	-1.907***	-2.322***	-0.884*	-0.998**	-0.716	-1.130***
	(-3.88)	(-5.18)	(-2.24)	(-2.83)	(-1.91)	(-3.47)
$aBDIND_{i,t}$	-0.007	0.008	0.010	-0.011	0.006	0.001
	(-0.52)	(0.76)	(1.04)	(-1.21)	(0.63)	(0.13)
$aACIND_{i,t}$	0.007	-0.012	0.007	-0.006	0.006	-0.010
	(0.74)	(-1.65)	(0.97)	(-0.95)	(0.90)	(-1.85)
$CYCLE_{i,t}$	3.497*	0.979	0.752	3.289***	-0.688	1.913*
	(2.55)	(0.83)	(0.68)	(3.53)	(-0.66)	(2.22)
$DISTRESS_{i,t-1}$	0.913	1.040*	0.012	0.104	-0.546	0.044
	(1.76)	(2.31)	(0.03)	(0.29)	(-1.39)	(0.14)
$aLOGMVE_{i,t-1}$	-0.003	-0.001	-0.006***	-0.003*	-0.005***	-0.003**
	(-1.83)	(-0.63)	(-4.23)	(-2.34)	(-4.20)	(-3.00)
$aLOGMTB_{i,t-1}$	0.013***	0.003	0.018***	0.008***	0.016***	0.010***
	(4.73)	(1.33)	(8.04)	(3.67)	(7.79)	(5.11)

Table 7A (Continued)

	DAC		DWAC		DAMP	
	High Incentive	**Low Incentive**	**High Incentive**	**Low Incentive**	**High Incentive**	**Low Incentive**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$aLEV_{i,t-1}$	-0.053***	-0.030*	-0.036**	-0.027**	-0.034**	-0.021*
	(-3.78)	(-2.38)	(-3.22)	(-2.77)	(-3.21)	(-2.29)
$aNOA_{i,t-1}$	-0.000	0.000	-0.000	-0.000**	-0.000	-0.000
	(-1.91)	(0.84)	(-0.75)	(-2.81)	(-0.49)	(-1.15)
Constant	0.064***	0.070***	0.055***	0.051***	0.046***	0.050***
	(8.80)	(11.14)	(9.43)	(10.27)	(8.35)	(10.87)
Observations	1750	1645	1750	1645	1750	1645
Adjusted R^2	0.0978	0.0732	0.1007	0.0915	0.1030	0.0860

Note: This table reports the estimations of equation (2): $EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 aBDIND_{i,t} + \beta_6 aACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 aLOGMVE_{i,t-1} + \beta_{10} aLOGMTB_{i,t-1} + \beta_{11} aLEV_{i,t-1} + \beta_{12} aNOA_{i,t-1} + \varepsilon$,

where $EM_{i,t}$ is $DAC_{i,t}$ (columns 1 and 2), $DWAC_{i,t}$ (columns 3 and 4), or $DAMP_{i,t}$ (columns 5 and 6). We run regressions for subsamples of firms whose CEOs have high and low equity-based incentives respectively. Firms are defined as having CEOs with high (low) equity-based incentives if *INCENTIVE* is greater than or equal to (lower than) the median across all firms. All coefficients are multiplied by 100 for easy reading. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

Table 7B Effect of Equity-based Incentives of CEOs on Relationship between PSCORE and Deviations of First Digits from Benford's Law

	FSD_SCORE		**KS**	
	High Incentive	**Low Incentive**	**High Incentive**	**Low Incentive**
	(1)	**(2)**	**(3)**	**(4)**
$PSCORE_{i,t}$	**0.048****	**0.027**	**0.176***	**0.084**
	(2.81)	**(1.50)**	**(2.49)**	**(1.15)**
$SEO_{i,t}$	-0.001	-0.040	-0.149	-0.235
	(-0.02)	(-0.60)	(-0.62)	(-0.86)
$M\&A_{i,t}$	-0.178	-0.048	-0.618	0.341
	(-1.70)	(-0.37)	(-1.43)	(0.63)
$AUDIT_{i,t}$	-0.120*	-0.039	-0.364	-0.604*
	(-2.18)	(-0.62)	(-1.61)	(-2.36)
$BDIND_{i,t}$	0.047	0.134	0.123	0.818
	(0.35)	(0.96)	(0.23)	(1.43)
$ACIND_{i,t}$	0.018	0.022	-0.124	-0.105
	(0.20)	(0.25)	(-0.33)	(-0.29)
$CYCLE_{i,t}$	-0.216	0.003	-0.105	-0.288
	(-1.51)	(0.02)	(-0.18)	(-0.46)
$DISTRESS_{i,t-1}$	0.076	0.086	0.198	0.445
	(1.32)	(1.46)	(0.85)	(1.84)
$LOGMVE_{i,t-1}$	-0.103***	-0.170***	-0.317***	-0.437***
	(-5.64)	(-8.10)	(-4.21)	(-5.07)
$LOGMTB_{i,t-1}$	0.160***	0.154***	0.441***	0.576***
	(5.51)	(4.94)	(3.70)	(4.48)
$LEV_{i,t-1}$	-0.370*	-0.283	-0.858	-1.446
	(-2.18)	(-1.53)	(-1.23)	(-1.90)
$NOA_{i,t-1}$	-0.001	0.000**	-0.003*	0.000
	(-1.96)	(2.87)	(-2.03)	(0.96)
Constant	0.041***	0.051***	0.108***	0.136***
	(15.14)	(19.41)	(9.74)	(12.49)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	1638	1559	1638	1559
Adjusted R^2	0.1236	0.1487	0.0761	0.0993

Note: This table reports the estimations of equation (3): $ERROR_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 BDIND_{i,t} + \beta_6 ACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 LOGMVE_{i,t-1} + \beta_{10} LOGMTB_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} NOA_{i,t-1} + INDUSTRY/YEAR\ FIXED\ EFFECTS + \varepsilon$,

where $ERROR_{i,t}$ is $FSD\_SCORE_{i,t}$ (columns 1 and 2) or $KS_{i,t}$ (columns 3 and 4). We run regressions for subsamples of firms whose CEOs have high and low equity-based incentives respectively. Firms are defined as having CEOs with high (low) equity-based incentives if *INCENTIVE* is greater than or equal to (lower than) the median across all firms.

All coefficients are multiplied by 100 for easy reading. Industry fixed effects are based on Datastream's Level 6 codes. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

CEOs than that with low equity-based incentive CEOs, in every empirical setting. Importantly, the coefficients on the PSCORE are mostly statistically significant when CEOs have high equity-based incentives (i.e. columns 1, 3, and 5 in Table 7A, and columns 1 and 3 in Table 7B), while they are not statistically significant when CEOs have low equity-based incentives (i.e. columns 2, 4, and 6 in Table 7A, and columns 2 and 4 in Table 7B).

In general, the results are consistent with the conjecture that the relationships between the PSCORE, and discretionary accruals and deviations of first digits from Benford's Law respectively, are stronger for firms whose CEOs have high equity-based incentives. The findings provide collaborative evidence that strengthens our Hypothesis 1, that the PSCORE is positively associated with low earnings quality.

4.6 Robustness checks

4.6.1 A practical version of the PSCORE

One concern with our approach to constructing the PSCORE is that the measure of pPRESS (press coverage) may be biased. Although Milbourn (2003), Francis et al. (2008), and Jian and Lee (2011) find that, overall, the newspapers fairly present the reputations of CEOs, Lafond (2008) argues that not all news is good news for CEOs' reputations. Also, one of the main purposes of this study is to develop a tool which can easily be applied, and the average practitioner may find it difficult to measure press coverage. To deal with those concerns, we build a practical version of the PSCORE, denoted by PSCORE_P, which excludes pPRESS. The calculation of the PSCORE now becomes:

$$PSCORE\_P_{i,t} = pCFO_{i,t} + pCERT_{i,t} + pROLE_{i,t} + pROA_{i,t} + pEARLY_{i,t} + pFOUNDER_{i,t} + pCHAIRMAN_{i,t} + pAGE_{i,t} \quad (4)$$

The practical PSCORE only includes measures whose data are collected from the curriculum vitae of CEOs and the financial statements of their companies. We re-run equations (2) and (3), replacing the PSCORE with PSCORE_P. The evidence (not tabulated) indicates that the coefficients on PSCORE_P are still positive and statistically significant. In other words, there are strong positive relationships between PSCORE_P and both discretionary accruals and deviations from Benford's Law. In general, the findings suggest that the average practitioner could apply PSCORE_P to detect cases where reported earnings have low quality.

4.6.2 Propensity score matching

A potential problem with non-experimental study is that estimations of multiple regressions may be biased because of model misspecifications (Shipman et al. 2017). In this study, the allocation of CEOs with high and low PSCOREs is not random. Thus, the average treatment effect of the PSCORE on earnings quality may be biased. There may be confounding factors which determine both earnings quality and the allocation of CEOs with high and low PSCOREs.

We follow previous studies (Shipman et al. 2017; Nguyen et al. 2020) and use the propensity score matching method to reduce any estimation bias caused by confounding factors. The procedure is as follows. First, we need to identify observations with high and low PSCOREs. We create a dummy variable, $highPSCORE$, which equals one if the CEO's PSCORE is greater than or equal to 5, and zero otherwise. We classify observations into two groups: treatment ($highPSCORE$ = 1) and control ($highPSCORE$ = 0). Second, we run a logistic regression between $highPSCORE$ and explanatory variables consisting of the control variables used in the main regression described by equation (2). After that, we calculate the conditional odds ratio of having a CEO with a high PSCORE. Third, we match (without replacement) each treatment observation to the control observation which has the closest odds ratio, requiring a maximum calliper of 0.01. Fourth, to assess the matching quality, we use a simple t-test to determine whether the remaining differences between the treatment and control observations are insignificant. The above four-step procedure for the propensity score matching model is similar to the recommendations of Shipman et al. (2017).

The results of the propensity score matching procedure are presented in Table 8A. Panel A shows the estimations of the logistic regression. The matched sample has 2,180 observations, with 1,090 treatment and 1,090 control observations. Panel B reports the results of t-tests, under the null that the mean difference in firm characteristics between the two groups is zero. The evidence shows that, while the mean differences in firm characteristics are significant in the full sample, all of the differences are insignificant at the 10% level in the matched sample, suggesting that the matching method is of a high quality. Using this propensity score matched sample, Table 8B provides evidence consistent with the main result, that the PSCORE is positively associated with discretionary accruals. We also find a positive and significant association between the PSCORE and deviations of first digits from Benford's Law (not tabulated). In general, the evidence is in line with Hypothesis 1.

Table 8A Propensity Score Matching

Panel A: Logistic model		
	Coefficient	**z-statistic**
$SEO_{i,t}$	0.104*	1.72
$M\&A_{i,t}$	-0.03	-0.26
$AUDIT_{i,t}$	-0.138**	-2.57
$BDIND_{i,t}$	-0.303**	-2.41
$ACIND_{i,t}$	-0.297***	-3.7
$CYCLE_{i,t}$	0.135	0.91
$DISTRESS_{i,t-1}$	0.183***	3.35
$LOGMVE_{i,t-1}$	-0.141***	-8.72
$LOGMTB_{i,t-1}$	0.133***	5.06
$LEV_{i,t-1}$	-0.404**	-2.56
$NOA_{i,t-1}$	0	-1.08
Constant	1.893***	12.26
Observations	3,395	
Pseudo R2	0.0958	

Panel B: Mean differences in firm characteristics before and after matching						
	Before matching (a)			**After matching (b)**		
	Treated	**Control**	**t-statistic**	**Treated**	**Control**	**t-statistic**
$SEO_{i,t}$	0.306	0.172	8.37***	0.182	0.182	0
$M\&A_{i,t}$	0.045	0.04	0.72	0.042	0.043	-0.1
$AUDIT_{i,t}$	0.407	0.639	-13.11***	0.609	0.621	-0.56
$BDIND_{i,t}$	0.298	0.416	-14.14***	0.395	0.398	-0.33
$ACIND_{i,t}$	0.035	0.152	-12.62***	0.095	0.088	0.61
$CYCLE_{i,t}$	0.042	0.018	3.54***	0.023	0.021	0.29
$DISTRESS_{i,t-1}$	0.371	0.227	8.46***	0.216	0.234	-1
$LOGMVE_{i,t-1}$	10.3	11.745	-20.76***	11.405	11.413	-0.11
$LOGMTB_{i,t-1}$	0.702	0.682	0.54	0.669	0.644	0.63
$LEV_{i,t-1}$	0.119	0.16	-7.5***	0.141	0.146	-0.9
$NOA_{i,t-1}$	10.581	9.558	0.15	8.144	4.534	1
Observations	1099	2296		1,090	1,090	

Note: This table reports the results of the propensity score matching approach.

Panel A reports the estimations of the following logistic regression: $Prob(highPSCORE_{i,t} = 1) = \alpha + \beta_1 SEO_{i,t} + \beta_2 M\&A_{i,t} + \beta_3 AUDIT_{i,t} + \beta_4 BDIND_{i,t} + \beta_5 ACIND_{i,t} + \beta_6 CYCLE_{i,t} + \beta_7 DISTRESS_{i,t-1} + \beta_8 LOGMVE_{i,t-1} + \beta_9 LOGMTB_{i,t-1} + \beta_{10} LEV_{i,t-1} + \beta_{11} NOA_{i,t-1}$. We match each treatment observation (highPSCORE=1) with one control observation (highPSCORE = 0) without replacement, where highPSCORE equals one if PSCORE is greater than or equal to the median across all firms, and zero otherwise. We require a maximum calliper of 0.01 (odds ratio) for matched samples.

Panel B reports the means of the firm characteristics before matching (column a) and after matching (column b), and the t-statistic for a t-test under the null that the mean difference between the treated and control groups is zero.

Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

Table 8B Propensity Score Matching: PSCORE and Discretionary Accruals

	DAC (a)		*DWAC (b)*		*DAMP (c)*	
	Coefficient	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
$PSCORE_{i,t}$	**0.280***	**(2.39)**	**0.089**	**(0.94)**	**0.180***	**(2.05)**
$SEO_{i,t}$	2.130***	(4.83)	1.253***	(3.55)	1.237***	(3.75)
$M\&A_{i,t}$	1.996*	(2.43)	4.293***	(6.53)	3.468***	(5.64)
$AUDIT_{i,t}$	-2.250***	(-6.16)	-1.186***	(-4.06)	-1.163***	(-4.26)
$aBDIND_{i,t}$	0.004	(0.39)	-0.013	(-1.67)	-0.012	(-1.69)
$aACIND_{i,t}$	-0.003	(-0.40)	0.001	(0.22)	-0.004	(-0.73)
$CYCLE_{i,t}$	2.272*	(2.04)	1.592	(1.78)	0.453	(0.54)
$DISTRESS_{i,t-1}$	1.195**	(2.97)	0.179	(0.56)	-0.226	(-0.75)
$aLOGMVE_{i,t-1}$	-0.002	(-1.47)	-0.003**	(-2.98)	-0.003**	(-2.71)
$aLOGMTB_{i,t-1}$	0.008***	(3.78)	0.011***	(6.29)	0.011***	(6.69)
$aLEV_{i,t-1}$	-0.037***	(-3.37)	-0.023**	(-2.63)	-0.024**	(-2.92)
$aNOA_{i,t-1}$	0.000	(0.41)	-0.000	(-1.64)	-0.000	(-0.39)
Constant	0.069***	(13.20)	0.058***	(13.91)	0.053***	(13.66)
Observations	2180		2180		2180	
Adjusted R^2	0.0624		0.0712		0.0709	

Note: Using the propensity score matched sample, this table shows the results of the following regression: $EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 aBDIND_{i,t} + \beta_6 aACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 aLOGMVE_{i,t-1} + \beta_{10} aLOGMTB_{i,t-1} + \beta_{11} aLEV_{i,t-1} + \beta_{12} aNOA_{i,t-1} + \varepsilon$,

where $EM_{i,t}$ can be DAC (column a), $DWAC$ (column b), or $DAMP$ (column c) (used as substitutes). All coefficients are multiplied by 100 for easy reading. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

4.6.3 CEO overconfidence

In the next robustness test, we examine whether the results hold when including a proxy for CEO overconfidence. Existing literature (e.g., Galasso and Simcoe 2011; Hirshleifer et al. 2012) indicates a relationship between CEO overconfidence and earnings management (Schrand and Zechman 2012; Ahmed and Duellman 2013; Hsieh et al. 2014). For example, Schrand and Zechman (2012) examine a sample of firms subject to Accounting and Auditing Enforcement Releases by the US Securities and Exchange Commission (AAERs) and report that CEO overconfidence is directly related to the likelihood of misstated earnings, suggesting an optimistic bias among overconfident CEOs that causes financial reporting misstatements. In this section, we expand the PSCORE to include an accounting-based measure of CEO overconfidence (Campbell et al. 2011; Schrand and Zechman 2012; Kim et al. 2016). The PSCORE with CEO overconfidence, denoted by PSCORE_O, is then used in the regressions described in equations (2) and (3).

Table 9A PSCORE, CEO Overconfidence, and Discretionary Accruals

	DAC (a)		***DWAC (b)***		***DAMP (c)***	
	Coefficient	***t-statistic***	***Coefficient***	***t-statistic***	***Coefficient***	***t-statistic***
$PSCORE\_O_{i,t}$	**0.283******	**(2.79)**	**0.231******	**(2.85)**	**0.338******	**(4.45)**
$SEO_{i,t}$	3.111***	(8.29)	2.177***	(7.27)	1.824***	(6.51)
$M\&A_{i,t}$	1.174	(1.61)	3.044***	(5.23)	2.938***	(5.39)
$AUDIT_{i,t}$	-2.140***	(-6.42)	-0.972***	(-3.66)	-0.931***	(-3.74)
$aBDIND_{i,t}$	0.000	(0.00)	-0.001	(-0.20)	0.002	(0.38)
$aACIND_{i,t}$	-0.002	(-0.29)	0.001	(0.25)	-0.001	(-0.34)
$CYCLE_{i,t}$	2.264**	(2.49)	2.107***	(2.91)	0.617	(0.91)
$DISTRESS_{i,t-1}$	0.920***	(2.67)	-0.043	(-0.16)	-0.350	(-1.36)
$aLOGMVE_{i,t-1}$	-0.002**	(-2.06)	-0.004***	(-4.70)	-0.004***	(-5.09)
$aLOGMTB_{i,t-1}$	0.010***	(5.16)	0.014***	(9.09)	0.014***	(9.84)
$aLEV_{i,t-1}$	-0.043***	(-4.58)	-0.034***	(-4.49)	-0.030***	(-4.29)
$aNOA_{i,t-1}$	-0.000	(-1.07)	-0.000**	(-2.47)	-0.000	(-1.19)
Constant	0.068***	(13.87)	0.051***	(13.14)	0.046***	(12.50)
Observations	3395		3395		3395	
Adjusted R^2	0.0903		0.0994		0.1013	

Note: This table reports the findings when the PSCORE includes a measure of CEO overconfidence. We run the following regression:

$$EM_{i,t} = \alpha + \beta_1 PSCORE\_O_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 aBDIND_{i,t} + \beta_6 aACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 aLOGMVE_{i,t-1} + \beta_{10} aLOGMTB_{i,t-1} + \beta_{11} aLEV_{i,t-1} + \beta_{12} aNOA_{i,t-1} + \varepsilon,$$

where $EM_{i,t}$ is replaced by $DAC_{i,t}$ (column a), $DWAC_{i,t}$ (column b) or $DAMP_{i,t}$ (column c). All coefficients are multiplied by 100 for easy reading. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

Table 9B PSCORE, CEO Overconfidence and Financial Statement Errors

	FSD_SCORE (a)		***KS (b)***	
	Coefficient	***t-statistic***	***Coefficient***	***t-statistic***
$PSCORE\_O_{i,t}$	**0.021***	**(1.75)**	**0.086***	**(1.77)**
$SEO_{i,t}$	-0.016	(-0.38)	-0.156	(-0.87)
$M\&A_{i,t}$	-0.141*	(-1.72)	-0.276	(-0.82)
$AUDIT_{i,t}$	-0.087**	(-2.15)	-0.442***	(-2.67)
$BDIND_{i,t}$	0.072	(0.77)	0.337	(0.88)
$ACIND_{i,t}$	0.002	(0.04)	-0.127	(-0.49)
$CYCLE_{i,t}$	-0.148	(-1.44)	-0.332	(-0.79)
$DISTRESS_{i,t-1}$	0.100**	(2.47)	0.381**	(2.30)
$LOGMVE_{i,t-1}$	-0.131***	(-9.69)	-0.383***	(-6.90)
$LOGMTB_{i,t-1}$	0.156***	(7.53)	0.488***	(5.76)
$LEV_{i,t-1}$	-0.391***	(-3.24)	-1.312***	(-2.65)
$NOA_{i,t-1}$	0.000**	(2.27)	0.000	(0.52)
Constant	0.046***	(25.35)	0.125***	(16.66)
Observations	3197		3197	
Adjusted R2	0.1286		0.0854	

Note: This table reports the findings when the PSCORE includes a measure of CEO overconfidence. We run the following regression:

$$ERROR_{i,t} = \alpha + \beta_1 PSCORE\_O_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 AUDIT_{i,t} + \beta_5 BDIND_{i,t} + \beta_6 ACIND_{i,t} + \beta_7 CYCLE_{i,t} + \beta_8 DISTRESS_{i,t-1} + \beta_9 LOGMVE_{i,t-1} + \beta_{10} LOGMTB_{i,t-1} + \beta_{11} LEV_{i,t-1} + \beta_{12} NOA_{i,t-1} + INDUSTRY/YEAR\ FIXED\ EFFECTS + \varepsilon,$$

where $ERROR_{i,t}$ is $FSD\_SCORE_{i,t}$ (column a) or $KS_{i,t}$ (column b). All coefficients are multiplied by 100 for easy reading. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

Table 9A reports the findings from regression (2), where the main variable of interest is PSCORE_O. In all columns, we find that the coefficients on PSCORE_O are positive and significant at 1%. Also, we observe that the magnitudes of the coefficients on the PSCORE_O are higher than those reported in Table 6 of the main findings, in nearly every case, suggesting that CEO overconfidence is another valid indicator of earnings quality. Similarly, the relationships between financial statement errors and PSCORE_O, as reported in Table 9B, are positive and significant. The findings continue to hold strongly when the PSCORE includes CEO overconfidence.

4.6.4 The PSCORE and real earnings management

Next, we are interested in seeing whether there is any relationship between the PSCORE and proxies for real earnings management. Roychowdhury (2006) argues that manipulation of earnings through real business transactions (e.g., increased price discounts or more lenient credit terms, overproduction, and cut down or delayed discretionary expenditures) leads to abnormal cash flows from operations, abnormal production costs, and abnormal discretionary expenses. Although we use a proxy in the first analysis, we perform a manipulation check by using real earnings management indicators, as in previous studies (Roychowdhury 2006; Athanasakou et al. 2009; Cohen and Zarowin 2010; Zang 2012). We take into account abnormal cash flows (*DCF*), abnormal production costs (*DPROD*), and abnormal discretionary expenditures (*DDISEXP*).[12] We also have a measure of total real earnings management (*REM*), where *REM* = *DCF* + *DPROD* + *DDISEXP*. We run the following regression:

$$EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 aBDIND_{i,t} + \beta_5 aACIND_{i,t} + \beta_6 CYCLE_{i,t} + \beta_7 DISTRESS_{i,t-1} + \beta_8 aLOGMVE_{i,t-1} + \beta_9 aLOGMTB_{i,t-1} + \beta_{10} aLEV_{i,t-1} + \varepsilon \quad (5)$$

where $EM_{i,t}$ can be $DCF_{i,t}$, $DPROD_{i,t}$, $DDISEXP_{i,t}$, or $REM_{i,t}$ (used as substitutes). In equation (5), we do not include the auditor or net operating accruals control variables, because there is little knowledge of how those factors influence real earnings management. As reported in Table 10, the coefficients on all the proxies for real earnings management are positive and statistically significant at least at the 10% level.

4.6.5 Other tests

Our main sample excludes joint CEOs as their impact on earnings quality might be unclear. In a robustness test, we include joint CEOs in the sample. For companies with joint CEOs, we select the one with potentially the greater influence on the preparation and review of the financial statements, based on three-stage criteria. In the first stage, we select CEOs based on CEO status at year-end. If joint CEOs both have CEO status at year-end, in the second stage, we choose the CEO who has worked at the company for longer. If we still cannot separate them, in the third stage, we choose the one with the higher salary. As a result, the sample increases from 3,395 to 3,433 firm-year observations (618 unique companies in 49 industries). The results (not tabulated) do not

[12] We note that we measure real earnings management using the absolute values of residuals estimated from the models of Roychowdhury (2006) for consistency with the construction of the PSCORE, which is designed to signal earnings quality without a particular emphasis on the directional effects of earnings management. When we use the real values of the residuals, the findings show that the coefficients on the PSCORE are still positive. Generally, the results seem to support the notion that the PSCORE is positively associated with the established proxies for real earnings management.

Table 10. Relationships between PSCORE and Proxies for Real Earnings Management

Variable	*DCF (a)*		*DPROD (b)*		*DDISEXP (c)*		*REM (d)*	
	Coefficient	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
$PSCORE_{i,t}$	**1.142*****	**(3.78)**	**0.491***	**(1.87)**	**0.604***	**(1.78)**	**1.949*****	**(3.09)**
$SEO_{i,t}$	3.5***	(3.23)	-1.362	(-1.43)	3.144***	(2.61)	-1.456	(-0.64)
$M\&A_{i,t}$	2.43	(1.17)	5.62***	(3.09)	3.941*	(1.72)	10.301**	(2.4)
$aBDIND_{i,t}$	-1.571	(-0.64)	2.709	(1.3)	-0.625	(-0.23)	-0.95	(-0.18)
$aACIND_{i,t}$	3.868**	(2.23)	1.018	(0.68)	3.725*	(1.88)	9.197**	(2.51)
$CYCLE_{i,t}$	5.84**	(2.22)	5.132**	(2.25)	3.465	(1.21)	5.235	(0.99)
$DISTRESS_{i,t-1}$	4.503***	(4.41)	-0.239	(-0.26)	3.414***	(2.99)	1.685	(0.79)
$aLOGMVE_{i,t-1}$	-0.248	(-0.77)	-1.783***	(-6.49)	-1.424***	(-3.97)	-2.239***	(-3.37)
$aLOGMTB_{i,t-1}$	3.73***	(6.76)	5.978***	(12.39)	5.848***	(9.53)	10.491***	(9.11)
$aLEVtm1_{i,t-1}$	-12.414***	(-4.55)	-5.955**	(-2.51)	-19.408***	(-6.46)	-26.335***	(-4.71)
Constant	7.451***	(5.92)	16.822***	(15.48)	15.854***	(11.16)	28.923***	(11)
Observations	3139		3014		2650		2547	
Adjusted R2	0.052		0.068		0.077		0.057	

Note: This table reports the estimations of the equation $EM_{i,t} = \alpha + \beta_1 PSCORE_{i,t} + \beta_2 SEO_{i,t} + \beta_3 M\&A_{i,t} + \beta_4 aBDIND_{i,t} + \beta_5 aACIND_{i,t} + \beta_6 CYCLE_{i,t} + \beta_7 DISTRESS_{i,t-1} + \beta_8 aLOGMVE_{i,t-1} + \beta_9 aLOGMTB_{i,t-1} + \beta_{10} aLEV_{i,t-1} + \varepsilon$,

where $EM_{i,t}$ is $DCF_{i,t}$, $DPROD_{i,t}$, $DDISEXP_{i,t}$, and $REM_{i,t}$ in columns (a), (b), (c), and (d), respectively (used as substitutes). All coefficients are multiplied by 100 for easy reading. Figures in parentheses are t-statistics. Variable definitions are provided in the appendix. *, **, and *** show significance at 10%, 5%, and 1%, respectively.

change qualitatively. In general, the findings from this robustness test provide evidence to strengthen our most important finding that the PSCORE could act as a red flag for poor earnings quality.

5 Conclusions

This research develops a composite score, namely the PSCORE, which captures the profile of the CEO, and examines whether it can provide a signal as to quality of earnings. Based on prior research, the PSCORE aggregates nine aspects of the CEO profile. We employ different types of proxies for earnings quality, namely discretionary accruals (Jones 1991; Dechow et al. 1995; Peasnell et al. 2000) and financial statement errors measured by deviations of first digits of figures reported in financial statements from Benford's Law (Amiram et al. 2015). Using a sample of 3,395 firm-year observations (615 unique firms) of listed companies on the London Stock Exchange from 2005 to 2012, the study finds that the PSCORE is positively associated with discretionary accruals and deviations of first digits from Benford's Law. The relationships are statistically and economically significant. Further analyses indicate that the associations between the PSCORE and established proxies for earnings quality become more pronounced when CEOs have high equity-based incentives. The findings are robust to several robustness tests. In general, the results demonstrate that the PSCORE can be used as an effective tool to red flag poor earnings quality.

The paper contributes to the existing literature and practice in several ways. First, the PSCORE developed here is easy to construct because it mainly requires data collected from the curriculum vitae of CEOs. Second, the study is the first of its kind to aggregate various characteristics of CEOs to signal earnings quality. Third, the PSCORE can highlight the presence of different kinds of earnings manipulation – accrual earnings management and financial statement errors – regardless of whether biases in financial statements result from intentional or unintentional acts of managers. This suggests that the PSCORE could be a useful risk indicator for practitioners who need an easy way to identify risks of poor earnings quality. The findings are relevant for research not only in the UK but also in the US and other international contexts.

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APPENDIX: Variable Definitions

Variable	Definition
Individual factors of the PSCORE	
pAGE	equals one if either (i) the age of the CEO is less than or equal to the 25th percentile of the industry-year (identified by Datastream Level 6) or (ii) the CEO is one year or less from retirement age, and zero otherwise. The retirement ages of men and women in the UK are 65 and 60, respectively, for the period from 1948 to 2010; from April 2010 to March 2020, the retirement age of women increases by one month every month until it reaches 65 (Bozio et al. 2010).
pCERT	equals one if the CEO does not have an MBA or CPA equivalent, and zero otherwise. CPA equivalent is defined as a professional accounting certification issued by one of the five qualifying bodies currently accredited by the Financial Reporting Council (FRC, 2016): Association of International Accountants (AIA), Chartered Certified Accountants (ACCA), Chartered Accountants Ireland (CAI), Institute of Chartered Accountants in England and Wales (ICAEW), Institute of Chartered Accountants of Scotland (ICAS) (or international equivalent certifications).
pCFO	equals one if the CEO does not have work experience as a chief financial officer, and zero otherwise.
pCHAIRMAN	equals one if the CEO serves as the chairperson of the board of directors of the firm, and zero otherwise.
pEARLY	equals one if the CEO is within their first three years of service at the firm, and zero otherwise.
pFOUNDER	equals one if the CEO is the founder or a co-founder of the firm, and zero otherwise.
pPRESS	equals one if the number of newspapers simultaneously citing the name of the CEO and the company they work for in the year question is less than the corresponding industry mean (identified by Datastream Level 6), and zero otherwise.
pROA	equals one if the average of the industry-adjusted return on assets (aveROA) during the last three years of the CEO's tenure is negative, and zero otherwise, where aveROA is (i) the average of the industry-adjusted return on assets in years *t*, *t-1* and *t-2* if the CEO is in their third year of tenure, or (ii) the average of the industry-adjusted return on assets in years *t* and *t-1* if the CEO is in their second year of tenure, or (iii) the industry-adjusted return on assets in year *t* if the CEO is in their first year of tenure. Return on assets equals net income before extraordinary items divided by total assets.
pROLE	equals one if the number of years the CEO has been working as the CEO of their current firm is less than the corresponding industry-year mean (identified by Datastream Level 6), and zero otherwise.
PSCORE	$= \text{pCFO} + \text{pCERT} + \text{pROLE} + \text{pPRESS} + \text{pROA} + \text{pEARLY} + \text{pFOUNDER} + \text{pCHAIRMAN} + \text{pAGE}$
PSCORE_O	PSCORE with CEO overconfidence: $$PSCORE\_O = PSCORE + CEO\_OVERCONFIDENCE$$ where $CEO\_OVERCONFIDENCE$ is CEO-level overconfidence. We first calculate the measure of firm-level overconfidence (Campbell et al. 2011; Schrand and Zechman 2012; Kim et al. 2016), denoted by $OVERCONFIDENCE$, which has a value of one if a firm-year observation meets at least three out of the following five conditions: (i) INVEST is ranked in the top industry-year (Datastream Level 6) quartile. INVEST is excess investment, which is the residual of the regression: $$\frac{Total\ Assets_{i,t} - Total\ Assets_{i,t-1}}{Total\ Assets_{i,t-1}} = \alpha + \beta \frac{Sale_{i,t} - Sale_{i,t-1}}{Sale_{i,t-1}} + \varepsilon$$

	(ii) ACQUISITION is ranked in the top industry-year (Datastream Level 6) quartile. ACQUISITION is equal to net acquisition (cash flow statements) scaled by total assets. (iii) The debt-to-equity ratio is ranked in the top industry-year (Datastream Level 6) quartile. The debt-to-equity ratio is equal to the sum of long-term debts and short-term debts divided by the market value of equity. (iv) Either convertible debt is greater than zero or preferred stock is greater than 0. (v) Zero dividend yield. Otherwise, it has a value of zero. Following Campbell et al. (2011) and Kim et al. (2016), CEO-level overconfidence takes a value of one starting from the first year in which the CEO's firm has a score for OVERCONFIDENCE equal to one.
Proxies for earnings quality	
DAC	Absolute values of discretionary total accruals (DAC), estimated by the modified-Jones models (Jones 1991; Dechow et al. 1995) with at least ten observations for each industry-year (Datastream Level 6). $DAC_{i,t} = \left\lvert \frac{AC_{i,t}}{A_{i,t-1}} - \left[\hat{\alpha} + \hat{\beta}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\beta}_2\left(\frac{\Delta REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right)\right]\right\rvert$; where $\hat{\alpha}, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3$ are coefficients estimated by the model: $\frac{AC_{i,t}}{A_{i,t-1}} = \alpha + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$; $AC_{i,t}$ is total accruals, which equals net income before extraordinary items minus net cash flows from operations; $A_{i,t-1}$ is total assets of firm *i* at end of year *t–1;* $\Delta REV_{i,t}$ and $\Delta REC_{i,t}$ are change in sales and change in receivables from year *t–1* to year *t* of firm *i,* respectively; $PPE_{i,t}$ is gross plant, property and equipment of firm *i* at end of year *t.*
DAMP	Absolute values of discretionary working capital accruals (DAMP) estimated by the margin model of Peasnell et al. (2000) with at least ten observations for each industry-year (Datastream Level 6). DAMP are the absolute values of the residuals of the following regression: $\frac{WAC_{i,t}}{A_{i,t-1}} = \alpha + \beta_1\left(\frac{REV_{i,t}}{A_{i,t-1}}\right) + \beta_2\left(\frac{REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$; $WAC_{i,t}$ is working capital accruals, $WAC_{i,t} = (\Delta CA_{i,t} - \Delta CHE_{i,t}) - (\Delta CL_{i,t} - \Delta STD_{i,t})$ [$\Delta CA_{i,t}$ is change in current assets; $\Delta CHE_{i,t}$ is change in cash and cash equivalents; $\Delta CL_{i,t}$ is change in current liabilities; $\Delta STD_{i,t}$ is change in short-term debts]; $A_{i,t-1}$ is total assets of firm *i* at end of year *t–1;* $REV_{i,t}$ is sales of firm *i* in year *t*; $\Delta REC_{i,t}$ is receivables from year *t–1* to year *t* of firm *i.*
DWAC	Absolute values of discretionary working capital accruals (DWAC) estimated by the modified-Jones models (Jones 1991; Dechow et al. 1995) with at least ten observations for each industry-year (Datastream Level 6). $DWCA_{i,t} = \left\lvert \frac{WAC_{i,t}}{A_{i,t-1}} - \left[\hat{\alpha} + \hat{\beta}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\beta}_2\left(\frac{\Delta REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right)\right]\right\rvert$; where $\hat{\alpha}, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3$ are coefficients estimated by the model: $\frac{WAC_{i,t}}{A_{i,t-1}} = \alpha + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$; $WAC_{i,t}$ is working capital accruals, $WAC_{i,t} = (\Delta CA_{i,t} - \Delta CHE_{i,t}) - (\Delta CL_{i,t} - \Delta STD_{i,t})$ [$\Delta CA_{i,t}$ is change in current assets; $\Delta CHE_{i,t}$ is change in cash and cash equivalents; $\Delta CL_{i,t}$ is change in current liabilities; $\Delta STD_{i,t}$ is change in short-term debts]; $A_{i,t-1}$ is total assets of firm *i* at end of year *t–1;* $\Delta REV_{i,t}$ and $\Delta REC_{i,t}$ are change in sales and change in receivables from year *t–1* to year *t* of firm *i* respectively; $PPE_{i,t}$ is gross plant, property and equipment of firm *i* at end of year *t.*
FSD_SCORE	Mean absolute deviation of the first digits of figures reported in the financial statements of firm *i* in year *t* from what are expected by Benford's Law. $FSD\_SCORE_{i,t} = \frac{\sum_{d=1}^{9}\lvert OBSERVED_{d,i,t}-EXPECTED_{d}\rvert}{9}$; where $OBSERVED_{d,i,t}$ is the observed (actual) probability of digit *d* of firm *i* in year *t*; $EXPECTED_d$ is the expected probability of first digit *d* as defined by Benford's Law; and *d* = 1, 2, …, 9.

KS	The maximum cumulative absolute deviation of the first digits of items reported in the financial statements from those expected by Benford's Law: $$KS_{i,t} = max\{\lvert OD_{1,i,t} - ED_1\rvert, \lvert(OD_{1,i,t} + OD_{2,i,t}) - (ED_1 + ED_2)\rvert, \ldots, \lvert(OD_{1,i,t} + OD_{2,i,t} + \cdots + OD_{9,i,t}) - (ED_1 + ED_2 + \cdots + ED_9)\rvert\}$$ where $OD_{d,i,t}$ is the cumulative observed probability of the first digit *d* (*d* = 1, 2, …, 9) of firm *i* in year *t*; ED_d is the expected probability of the first digit *d* (*d* = 1, 2, …, 9), as defined by Benford's Law.
DCF	Absolute value of abnormal cash flow. DCF is the absolute value of the residual of the following regression for each (Datastream Level 6) industry and each year with at least ten observations: $$\frac{CFO_{i,t}}{A_{i,t-1}} = \alpha + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{REV_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$$ where $CFO_{i,t}$ is net cash flows from operations; $A_{i,t-1}$ is total opening assets; $REV_{i,t}$ is sales; $\Delta REV_{i,t}$ is sales in year *t* minus sales in year *t-1; i* is firm *i; t* is the year; and $\varepsilon_{i,t}$ is the error term.
DDISEXP	Absolute value of abnormal discretionary expenditures. DDISEXP is the absolute value of the residual of the following regression for each (Datastream Level 6) industry and each year with at least ten observations: $$\frac{DISEXP_{i,t}}{A_{i,t-1}} = \alpha\left(\frac{1}{A_{i,t-1}}\right) + \beta_1\left(\frac{REV_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$$ where $DISEXP_{i,t}$ is discretionary expenditures, which equals R&D expenses plus selling and administrative expenses; A_{it-1} is total opening assets; $REV_{i,t-1}$ is sales in year t-1; *i* is the firm; *t* is the year; $\varepsilon_{i,t}$ is the error term.
DPROD	Absolute value of abnormal production costs. DPROD is the absolute value of the residual of the following regression for each (Datastream Level 6) industry and each year with at least ten observations: $$\frac{PROD_{it}}{A_{i,t-1}} = \alpha\left(\frac{1}{A_{i,t-1}}\right) + \beta_1\left(\frac{REV_{i,t}}{A_{i,t-1}}\right) + \beta_2\left(\frac{\Delta REV_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta REV_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t}$$ where $PROD_{i,t}$ is production costs, which equal the sum of cost of goods sold and change in inventories from year *t-1* to year *t*; $REV_{i,t}$ is sales; ΔREV_{it} is sales in year *t* minus sales in year *t-1*; ΔREV_{it-1} is sales in year *t-1* minus sales in year *t-2*; A_{it-1} is total opening assets; *i* is the firm; *t* is the year; $\varepsilon_{i,t}$ is the error term.
REM	Total real earnings management. REM = DCF + DPROD + DDISEXP
Control variables	
aACIND	Industry-adjusted audit committee independence, where audit committee independence is the percentage of independent members on the audit committee. Industry-adjusted value equals the firm value minus the mean for the corresponding industry-year.
aBDIND	Industry-adjusted board independence, where board independence is the percentage of independent directors on the board.
aLEV	Industry-adjusted leverage, where leverage (LEV) equals the sum of long-term debts and short-term debts, scaled by total assets.
aLOGMBT	Industry-adjusted market-to-book ratio, where the market-to-book ratio *(LOGMTB)* is the natural log of the ratio of the market value to the book value of equity.
aLOGMVE	Industry-adjusted firm size, where firm size *(LOGMVE)* equals the natural log of the market value of equity.
aNOA	Industry-adjusted net operating asset ratio (NOA), where $NOA = [CEQ + (DLTT + DLC) - CHE]/REV$, where CEQ is the total book value of equity, DLTT is long-term debts, DLC is short-term debts; CHE is cash and cash equivalent; REV is sales.

AUDIT	equals one if the firm is audited by a Big Four audit firm, and zero otherwise.
CYCLE	Indicator for the business life cycle, calculated based on Dickinson (2011), and equals one if a firm has negative CFO, negative CFI, and positive CFF (young firm), or positive CFO, negative CFI, and positive CFF (growth firm), and zero if a firm has positive CFO, negative CFI, and negative CFF (mature firm), where CFO is cash flows from operating activities, CFI is cash flows from investing activities, and CFF is cash flows from financing activities.
DISTRESS	equals one if ZSCORE is negative, and zero otherwise, where ZSCORE, following Taffler (1983), is calculated as follows: $\text{ZSCORE} = 3.2 + 12.18 * X_1 + 2.50 * X_2 - 10.68 * X_3 + 0.029 * X_4$, where $X_1 = \frac{\text{Profit before tax}}{\text{current liabilities}}$, $X_2 = \frac{\text{Current assets}}{\text{Total liabilities}}$, $X_3 = \frac{\text{Current liabilities}}{\text{Total assets}}$, and $X_4 = \frac{(\text{Quick assets} - \text{Current liabilities})}{(\text{Sales} - \text{Pretax income} - \text{Depreciation})/365}$.
INCENTIVE	Equity-based incentives of the CEO: $$INCENTIVE = \frac{ONEPCT}{(ONEPCT + SALARY + BONUS)}$$ $$ONEPCT = 0.01\ x\ PRICE\ x\ (SHARE + OPTION)$$ where $INCENTIVE$ is the equity-based incentives of the CEO; $ONEPCT$ is the dollar change in the CEO's equity holdings following a 1% change in the stock price; $PRICE$ is the closing share price; $SHARE$ is the number of shares held by the CEO; $OPTION$ is the number of options held by the CEO; $SALARY$ is the total cash salary the CEO receives; and $BONUS$ is the cash bonus the CEO receives. Compensation data are manually collected from the Bloomberg database.
M&A	equals one if a firm announces a share-financed merger and acquisition deal, and zero otherwise.
SEO	equals one if a firm issues a significant portion of equity (outstanding shares increase by at least 5% and proceeds from equity issuance are positive), and zero otherwise.