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Audit Committees and Earnings Management – Evidence from the German Two-Tier Board System

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Abstract This study investigates whether audit committees of German firms and their characteristics are related to earnings management. This issue is of particular interest, as it reveals the effectiveness of voluntarily established audit committees in a two-tier board system. In contrast, most prior research focuses on the characteristics of mandatory audit committees in one-tier board systems. We use a sample from German listed firms between 2005 and 2009, and accrual-based earnings management serves as a proxy for audit committee effectiveness. The results suggest that the existence of an audit committee is related to a lower degree of earnings management. Using a differences-in-differences approach, we also provide evidence that the level of earnings management decreases after the formation of an audit committee. Moreover, the results show that the participation of financial experts in audit committees and the increase in audit committee meetings are associated with less earnings management, i. e. these characteristics seem to enhance the effectiveness of audit committees. With respect to meeting frequency, 4–5 meetings per year seem to represent an effective number of meetings in order to reduce the level of earnings management.

Keywords Audit committees · Financial expert · Corporate governance · Two-tier board system · Earnings management · Abnormal accruals

JEL-Classification M4 · K2 · H1 · G3

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1 Introduction

The aim of this paper is to investigate the association between audit committees and their characteristics and earnings management in the German two-tier board system with voluntary audit committee establishment. Audit committees are charged with monitoring the financial reporting process and constraining opportunistic earnings management has been widely mentioned as one of the major benefits of firms that have established effective audit committees (e. g., Klein 2002a; Xie et al. 2003). In contrast to two-tier board systems, audit committees already have a long tradition in one-tier board systems and play a crucial role by separating the management and monitoring duties of the board of directors. In two-tier board systems, responsibilities are already split between management board and supervisory board, and audit committees act as a subgroup of the supervisory board. Their justification stems from national legislator concerns about the supervisory boards' monitoring strength, an issue which arose after the accountings scandals around the year 2000. Therefore, improving the supervisory board's monitoring process with regard to financial reporting quality (which includes the reduction of opportunistic earnings management), is considered as major responsibility of audit committees in two-tier board systems, which is also expressed by the German legislator (Bundestag-Drucksache 14/7515; paragraph 107 (3) 2 AktG). A survey study by Köhler (2005) of supervisory board chairpersons indicates that audit committees are indeed able to increase the monitoring effectiveness of supervisory boards of German firms.

In the U.S., as a predominant representative of the one-tier board system, audit committees are mandatory for all listed firms (Securities and Exchange Commission, Exchange Act Rule 10A-3). In contrast, in two-tier board systems and especially in Germany, legislators adopt an approach with a voluntary establishment of audit committees. The voluntary approach for EU member states is offered by Directive 2006/43/EG, Art. 41 (1), requiring audit committees of public interest entities with the option to usurp audit committee tasks to a supervisory board. Accordingly, the decision to establish audit committees is intentionally made by firms. In Germany, the voluntary approach is flanked by a "comply or explain" (why they did *not* form a committee) approach for listed firms (German Corporate Governance Code, GCGC Sec. 5.3.2; paragraph 107 (3) 2 and, 161 (1) AktG). There are both arguments for and against a voluntary approach. A mandatory approach yields better compliance and produces consistent standards among firms. The choice of establishing an audit committee under the voluntary approach is based on rational decisions made by firms, which might be better able individually to evaluate the benefits and costs arising (Anand 2005). Hence, differences in audit committee effectiveness might be observed, depending on whether audit committees are only established for legitimacy reasons in a mandatory setting or whether firms voluntarily establish effective audit committees.

Our paper examines the impact of audit committees on earnings management in the German voluntary setting. This setting allows for analyzing differences in earnings management, depending on the existence of audit committees. We further analyze the impact of audit committee characteristics, which are identified by the international literature as determining the effectiveness of audit committees, primar-

ily in one-tier board systems (e. g. DeZoort et al. 2002) on earnings management in this setting.

To analyze the association of audit committees and their characteristics with earnings management, we use a sample of 1462 firm-year observations of German firms listed on the regulated market of the Frankfurt stock exchange (CDAX), encompassing the period 2005-2009. We use this investigation period, as the German legislator has been increasing the requirements for firms with audit committees for fiscal years beginning in 2010. Audit committees have still been voluntary after 2009. However, firms with audit committees are obliged to include a financial expert in the committee (paragraph 107 (4) AktG in conjunction with paragraph 100 (5) AktG), which reduces the possibility to analyze the impact of financial expertise on earnings management. Furthermore, restricting the investigation period ensures a stable setting in which the playing field for audit committees remains unchanged, which reduces potential bias in measuring the impact of audit committee effectiveness. Our results suggest that the existence of an audit committee is related to less earnings management. Using a differences-in-differences approach, we also provide evidence that the level of earnings management decreases after the formation of an audit committee. Moreover, the results show that the participation of financial experts in audit committees and the increase in audit committee meetings are associated with less earnings management, i. e. these characteristics seem to enhance the effectiveness of audit committees. With respect to the meeting frequency, 4–5 meetings per year seem to represent an effective number of meetings in order to reduce the level of earnings management. We do not find any significant influence of audit committee size on earnings management, indicating that the number of audit committee members per se is less important, compared to the expertise of its members.

Our results contribute to the existing international literature, by providing evidence on the effectiveness of voluntarily established audit committees in a two-tier board system, a subject only sparsely addressed by prior research. The majority of empirical studies analyzing the association of audit committee characteristics with earnings management stem from Anglo-American countries or other countries where one-tier board systems are predominant (e. g., France and Spain). However, the different institutional settings, particularly with respect to board structure, and the mandatory establishment of audit committees, mean that those results are not fully generalizable to the German setting. Comparing the different board systems, there are advantages and disadvantages for both systems with respect to their ability to constrain earnings management. On the one hand, non-executive directors in the two-tier system are more independent, and might therefore be stricter in constraining earnings management. On the other hand, non-executive directors in the one-tier system perform their monitoring duties as full-time work, are more involved in the firm's operations and have direct access to information. Hence, they may be better able to constrain earnings management. Prior studies regarding the German setting only focus on individual and isolated features of audit committees. Ernstberger et al. (2012) analyze the impact of audit committee existence on erroneous IFRS financial statements in the German setting, while a study by Velte and Stiglbauer (2011) focuses on the implementation and financial expertise of audit committees. We extend this focus by analyzing not only the impact of existence of audit committees, but

also on audit committee formation, as well as of audit committee size and activity, which is not addressed directly by these studies. We further complement the results of Ernstberger et al. (2012) with regard to audit committee existence, to a broader level, by reflecting the usual reporting quality of German listed firms, as errors in financial accounting became not comprehensively publicly known (depending on DPR inspections) and often represent one-off events and therefore, they reflect only a part of financial reporting quality. We further supplement to the results of Velte and Stiglbauer (2011), as we control strictly for self-selection bias which may result from analyzing audit committee features in a setting with voluntary implementation.

The results from prior international studies related to audit committee characteristics and earnings management are mixed. We contribute to the international audit committee research by analyzing potential non-linear effects of specific audit committee characteristics on earnings management. By using squared regressions, we are further able to estimate an "optimal level" of those characteristics, at the point where earnings management exhibits the lowest level.

The remainder of the paper is organized as follows. To develop the study's hypotheses, Sect. 2 provides background information and an overview of prior research on the relationship between audit committees and their characteristics and earnings management. Sect. 3 describes the sample selection and model specification. Sect. 4 presents the empirical results and additional tests of audit committee formation are reported in Sect. 5. Sect. 6 contains robustness checks of our results and finally, Sect. 7 provides a discussion of the results and draws conclusions.

2 Literature Review and Hypotheses

2.1 Audit Committee Existence

The predominant theoretical basis of studies analyzing the relationship between audit committees and earnings management is agency theory (Jensen and Meckling 1976). Within the framework of the agency theory, there are information asymmetries and conflicts of interest between management and shareholders, enabling management to use its judgment in financial reporting to either mislead investors about the underlying economic performance of the firm or to influence contractual outcomes that depend on the reported earnings numbers (Healy and Wahlen 1999).[1] Strong internal and external monitoring mechanisms are expected to deter management from engaging in opportunistic reporting practices, due to an increased risk of detection and impending penalties and are therefore crucial for reducing information asymmetries (Jensen and Meckling 1976; Fama and Jensen 1983). In the German two-tier board system, the supervisory board is a major internal monitoring mechanism. However, given the size of the supervisory board, shared responsibility for the monitoring outcome can result in coordination failures and lower effort from

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[1] Management incentives to engage in such opportunistic reporting stem, for example from performance-related compensation arrangements, achieving earnings targets (e. g., reporting of yearly earnings increases, beating analyst forecasts, loss avoidance), or enhancing management reputation.

individual members (Köhler 2005; Wilke and van Knippenberg 1996) in detecting and constraining earnings management. This might deteriorate, given the fact that its members only work part-time and often have several mandates. As sub-group of the supervisory board, audit committees overcome this phenomenon, as they are able to work more telic (Deckert 1996). Therefore, they can enhance the supervisory board's monitoring strength[2] and reduce agency costs by directly monitoring financial reporting quality (Archambeault et al. 2008). Beside the supervisory board, internal and external auditing are further monitoring mechanisms that can benefit from audit committees, which can strengthen the external and internal auditor's position in cases of conflicts with management, regarding accounting issues.

Empirical evidence on the impact of audit committee existence on earnings management is limited, because audit committees have been mandatory in most countries with one-tier board systems for a long time. Furthermore, the results from existing studies are mixed. A U.S. study of Peasnell et al. (2005) for a research period in which audit committees were not yet mandatory (1993–1996) did not find a significant impact of audit committee existence on earnings management. However, the researchers concede that the results might be biased, as the majority of sample firms had voluntarily implemented audit committees. In contrast, Davidson et al. (2005) find a negative association between the existence of an audit committee and earnings management to achieve earnings targets for Australia. Regarding continental European countries, Piot and Janin (2007) document that the existence of an audit committee is related to lower earnings management in France. This is supported by the results of Ernstberger et al. (2012), who find a lower likelihood of erroneous IFRS financial statements in Germany, if audit committees exist, whereas Geraldes Alves (2011) and Velte and Stiglbauer (2011) do not find a significant association between the existence of an audit committee and earnings management in Portugal and Germany, respectively.

Merging the empirical results and the agency theory argumentation, we predict a negative relationship between audit committee existence and earnings management. We also concede finding no significant impact of audit committees on earnings management, which, for instance, occur if firms have audit committees only pro forma, to signal compliance with corporate governance standards. As no prior study finds a positive association between audit committee existence and earnings management, nor does the agency theory argument suggest that audit committees increase the level of earnings management, we formulate a alternative hypothesis, which we test one-tailed:

H1 The existence of audit committees is negatively associated with earnings management.

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[2] Following e. g. Lück (1990), Lück (1999) and Koprivica (2009), this aspect is substantial in the German two-tier board system.

2.2 Audit Committee Characteristics

In a setting with voluntary implementation of audit committees, the existence of a committee is a first indicator of stronger monitoring. Nevertheless, it is crucial that the organization and work of the audit committee are effective, in order to actually achieve positive monitoring effects. DeZoort et al. (2002) define composition, authority, resources and activity as the main determinants of audit committee effectiveness. Following prior empirical research on audit committee effectiveness, we use proxies for these determinants, based on publicly available data in Germany, to analyze their effect on earnings management (e. g., Klein 2002a; Bédard et al. 2004; Piot and Janin 2007; Ghosh et al. 2010).[3] Publicly available information on audit committee characteristics enables analyzing financial expertise as a proxy for the composition of audit committees, committee size as proxy for resources, and committee meetings as proxy for the activities of audit committees. Since audit committee authority is limited in two-tier board systems compared to one-tier board systems (Huck and Ammann 2003),[4] we abstain from analyzing authority.

2.2.1 Financial Expertise

Specialized knowledge in accounting and auditing (financial expertise) is needed for audit committee members to independently and meaningfully assess accounting issues presented to them (Baxter and Cotter 2009), to evaluate alternative accounting treatments or estimates or to discuss accounting estimates and assumptions involved in implementing new accounting policies (Beasly et al. 2009). Effective for fiscal years beginning 2010, paragraph 107 (4) AktG in conjunction with paragraph 100 (5) AktG requires at least one member of the audit committee to have expertise in accounting or auditing.

Several U.S. studies find that financial expertise of committee members is associated with lower earnings management (Xie et al. 2003; Bédard et al. 2004; Dhaliwal et al. 2010; Krishnan et al. 2011; Keune and Johnstone 2012; Bryan et al. 2013). Karamanou and Vafeas (2005) also show a positive influence of expertise on earnings quality, using the quality of earnings forecasts as a quality measure. Beyond the USA, Choi et al. (2004) show for Korea, that earnings management is lower when the audit committee has sufficient expertise. This result is confirmed by Woidtke and Yeh (2013), using data from three East Asian countries, and Sharma et al. (2011) for New Zealand. A German study of Velte and Stiglbauer (2011) state that financial expertise results in lower earnings management in cases where more than 50% of the audit committee members are experts. Only a few studies find no significant impact of financial expertise on earnings management (the U.K. study of Song and Windram (2004); Rainsbury et al. (2008) for New Zealand; Jamil and Nelson (2011) for Malaysia; and the U.S. study of Ghosh et al. (2010)). None of

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[3] Due to broad disclosure requirements in the U.S. these studies are based on a much higher accessibility level of audit committee data compared to Germany.

[4] The supervisory board has a superior position and is entitled to withdraw authorities or overrule committee decisions (Paefgen 1982; Rössler 2001).

the prior studies document a statistically positive association between financial expertise and earnings management. Therefore, we formulate the following alternative hypothesis, which is tested one-tailed:

H2 Audit committees with at least one financial expert are negatively associated with earnings management, compared to audit committees without a financial expert.

2.2.2 Audit Committee Size

Audit committees have to be vested with sufficient financial, informational or organization-related resources to effectively fulfill their duties. Most archival studies approximate resources by using audit committee size (number of audit committee members), which is publicly available information in most countries. However, the results of these prior studies are inconclusive. Some U.S. studies find that audit committee size is negatively associated with earnings management and positively with earnings quality (Ghosh et al. 2010; Yang and Krishnan 2005; Karamanou and Vafeas 2005), while other studies find no significant relationship (Xie et al. (2003) and Vafeas (2005) for the U.S.; Baxter and Cotter (2009) and Davidson et al. (2005) for Australia).

One explanation of the mixed empirical results could be a non-linear impact of audit committee size on earnings management (see also Vafeas 2005). According to paragraph 108 (2) 3 AktG and Koprivica (2009), less than three members is generally regarded as critical, as decision-making processes and voting procedures are then affected. Furthermore, when audit committees become too large, the positive effects might decline, as performance is reduced due to poorer communication, less efficient decision-making processes, and a diffusion of responsibility (Köhler 2005). The literature generally expects a critical number of six members, leading to the conclusion that the optimal range is three to six (Fischbach 2003; Koprivica 2009). Prior research only addresses potentially negative impacts of a small audit committee size, but do not test for similar impacts when audit committees become too large. For example, Bédard et al. (2004) test whether audit committees consisting of at least three members, compared to those with less than three, seem to have a negative impact on earnings management in the U.S., but they do not find significant evidence. Davidson et al. (2005) draw the same conclusion for a sample of Australian data.

Beside the potential non-linear effect of audit committee size, a further explanation of the mixed results might be that size per se is less important than the expertise of its members. The effect of size could rather be driven more by the fact that larger committees are more likely to include members with varied financial expertise and thus may monitor the financial reporting processes more effectively (Ghosh et al. 2010).

We formulate the following alternative hypothesis, which we test one-tailed:

H3 Both small and large audit committee size are positively associated with earnings management.

2.2.3 Audit Committee Meetings

The number of audit committee meetings (meeting frequency) is a proxy for the committee's activity level. Activity is determined by the willingness of audit committee members to fulfill their monitoring duties appropriately. Even with suitable composition and resources, a committee is obviously not capable of attaining positive effects on financial reporting quality if it is not active. Choi et al. (2004) state that active audit committees are more likely to detect earnings management than dormant committees. The results of prior studies are inconclusive. For the U.S., Xie et al. (2003), Vafeas (2005) and Yang and Krishnan (2005) find a significant negative association between the number of meetings and earnings management, and a positive relationship between meeting frequency and earnings quality, whereas Yang and Krishnan (2005) do not find a significant relationship. For Australia, Davidson et al. (2005) and Baxter and Cotter (2009) also find no significant impact of meeting frequency on earnings management. The results of further studies from Singapore and Malaysia are also mixed, ranging from a negative association (Van der Zahn and Tower 2004; Md Yusof 2010) to no association between meeting frequency and earnings management (Rashidah and Fairuzana 2006).

We also refer to the mixed results by assuming a non-linear relationship between meeting frequency and earnings management. We expect a range of approximately 4 to 6 meetings as sufficient to ensure financial reporting quality (quarterly meetings plus one or two with the auditors). One meeting suggests only a "pro forma" meeting. Empirical studies have tested thresholds of at least two, three and four meetings (Bédard et al. 2004; Lin et al. 2006), without finding any significant differences in earnings management when the meeting number is above or below the thresholds. We additionally assume that a higher number of audit committee meetings might indicate an ineffective functioning of the audit committee (e. g. attributable to short meetings, which implies that accounting issues are not adequately resolved, also essentially "pro forma" meetings, insufficient composition of the audit committee to adequately evaluate accounting issues). Hence, positive effects from one, to the range of a sufficient number of meetings, might subsequently reverse, and we therefore formulate the following alternative hypothesis, which we test one-tailed:

H4   Both low and high number of audit committee meetings are positively associated with earnings management.

3 Research Design

3.1 Sample

Our initial sample consists of all German firms that are listed on the regulated market of the Frankfurt Stock Exchange (CDAX) during the fiscal years 2005 and 2009. Consolidated financial statement and market data stem from the Worldscope database, freefloat data is from Bloomberg, whereas information on audit committee characteristics and external auditors are hand-collected from annual reports. In a first

Table 1 Summary of sample sizes used for hypotheses tests

Observations of CDAX listed firms between 2005 and 2009		3195
Less		
– Observations of banking, insurance, and financial services firms	695	
– Observations subject to insolvency, liquidation, merger and acquisition, other financially distresses, IPOs	477	
– Observations subject to accounting principles other than IFRS or short fiscal years	360	
– Firm-year observations of sectors with less than 7 comparable firms	54	
Sample for measuring earnings management		1609
– Observations subject to U.S. listing	26	
– Observations with missing data	121	
Sample for audit committee existence (hypothesis H$_1$)		**1462**
Less		
– Observations without an audit committee	775	
		687
Less (a)		
– Observations with missing information on financial expert	211	
Sample for financial expertise of audit committee (hypothesis H$_2$)		**476**
Or less (b)		
– Observations with missing information on audit committee members	178	
Sample for audit committee size (hypothesis H$_3$)		**509**
Or less (c)		
– Observations with missing information on audit committee meetings	31	
Sample for audit committee meetings (hypotheses H$_4$)		**656**

step, banks, insurance and other financial service firms are excluded.[5] We omit all observations of firms, if they undergo mergers and acquisitions, became insolvent, or are liquidated.[6] We also exclude observations of other financially distressed firms (with a negative book value of equity or zero sales). We delete observations of IPO firms and those of firms with a delisting during the sample period. Observations of firms applying accounting principles other than IFRS, and observations of firms with short fiscal years are excluded as well. To ensure a reliable estimation of discretionary accruals, we require at least seven firms per sector and year (Bartov et al. 2001). Hence, observations of firms with less than seven comparable firms are dropped from the sample. This results in a sample of 1609 firm-year observations for measuring earnings management. In a second step, we also drop observations of firms with U.S. cross-listing, because these firms are affected by the S.E.C.-enforcement system, which requires establishing an audit committee. Therefore, we are not able to analyze the effect of a voluntary audit committee for these firms. Finally,

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[5] These firms are subject to different financial reporting requirements that lead to a different structure of balance sheets and accruals, and thus reduce their comparability with other sample firms.

[6] First, these firms often do not have the relevant financial statement data. Second, the data could result in extreme outliers. Third, Collins and Hribar (2002) show that estimating accruals is problematic in this case.

we delete observations of firms with missing data on audit committees or on control variables. This leaves a final sample of 1462 firm-year observations from 401 firms, for testing the effect of audit committee existence on earnings management. Sub-samples for audit committee characteristics only include observations of firms with an audit committee and are further reduced by observations with missing information on financial experts, audit committee members, and meetings. The sub-sample for financial expertise of the audit committee consists of 476 firm-year observations, the sub-sample for audit committee size consists of 509 firm-year observations, and the sub-sample for audit committee meetings includes 656 firm-year observations. Our sample selection process is shown in Table 1.

3.2 Measurement of Earnings Management

Earnings management is used as proxy for the effectiveness of audit committees. We focus on discretionary accruals to measure earnings management. Cohen et al. (2007) state that the preservation of accruals quality is an important responsibility of the audit committee. Discretionary accruals are estimated cross-sectionally, as the residual from the following regression model (Kothari et al. 2005):[7]

$$
\begin{aligned}
TA_t = &\alpha_t(1/A_{t-1}) + \beta_t(\Delta REV_t - \Delta AR_t)/A_{t-1} + \gamma_t(PPE_t/A_{t-1}) + \\
&\delta_t ROA_t + \varepsilon_t
\end{aligned}
\tag{1}
$$

(See Table 2, Panel A for variable definitions). α_t, β_t, γ_t and δ_t are industry-year specifically estimated coefficients. Industries are classified by the DAX sectors of the Deutsche Boerse, which structure the market into 18 different industries. For our main analyses, we use the absolute value of discretionary accruals $|DA|$ as the dependent variable.

3.3 Model Specification

To test the paper's hypotheses, the following four multiple regression models are estimated. The models differ only with regard to the audit committee test variables, control variables are equal in all models (see Table 2 for variable definitions).

To test the association between discretionary accruals and audit committee existence (hypothesis H_1), a dichotomous variable *ACexist* is used as a test variable, representing whether or not an audit committee exists:

$$
|DA| = \beta_0 + \beta_1 ACexist + control\,variables + \varepsilon
\tag{2}
$$

To analyze the association between discretionary accruals and the financial expertise of audit committees (hypothesis H_2), we also use a dichotomous variable

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[7] See the empirical results of e. g. Dechow et al. (1995), Kang and Sivaramakrishnan (1995), Peasnell et al. (2000), Jones et al. (2008), which attest this model better specification and greater power to detect earnings management than the original and the modified Jones model.

Table 2 Definition of variables

Panel A: Earnings Management Variables

Variable	Predicted Sign	Definition
$|DA|$		Absolute values of discretionary accruals scaled by lagged total assets
DA^+		Absolute values of positive discretionary accruals ($DA > 0$), income-increasing earnings management
DA^-		Absolute values of negative discretionary accruals ($DA < 0$), income-decreasing earnings management
$|DWCA_t|$		Absolute values of discretionary working capital accruals scaled by lagged total assets
TA_t		Total accruals in year t, defined as net income less operating cash flow scaled by lagged total assets
WCA_t		Working capital accruals in year t, defined as EBITDA less operating cash flow scaled by lagged total assets
A_{t-1}		Total assets at the beginning of year t
ΔREV_t		Change in revenues from year t–1 to t
ΔAR_t		Change in accounts receivable from year t–1 to t
PPE_t		Gross property, plant, and equipment in year t
ROA_t		Return on assets in year t, defined as (net earnings before preferred dividends + interest expense on debt)*(1-tax rate) scaled by lagged total assets
CFO_t		Operating cash flow in year t
CFO_{t-1}		Operating cash flow in year t–1
CFO_{t+1}		Operating cash flow in year t+1

Panel B: Audit Committee Variables

Variable	Predicted Sign	Definition
ACexist	–	Audit committee existence (dichotomous variable), coded 1 if the firm has an audit committee, and 0 otherwise
ACexpert	–	Financial expertise of the audit committee (dichotomous variable), coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise
ACsize	–	Audit committee size, defined as the number of audit committee members
$ACsize^2$	+	Audit committee size squared
ACmeet	–	Audit committee meetings, defined as the number of audit committee meetings per fiscal year
$ACmeet^2$	+	Audit committee meetings squared
abnACsize	–	Abnormal audit committee size, measured as the residual from audit committee size on firm size
abnACmeet	–	Abnormal audit committee meetings, measured as the residual from audit committee meetings on firm size

Table 2 Definition of variables (Continued)

Panel C: Control Variables

Variable	Predicted Sign	Definition
Earnings Management Incentives		
Growth	+	Growth rate, defined as change in total assets compared to the previous fiscal year
Lev	+	Leverage ratio, defined as total liabilities divided by common equity
Loss	+	Negative net income, measured by a dichotomous variable with the value of 1 if the net income is negative, and 0 otherwise
NegCF	+	Negative operating cash flow, measured by a dichotomous variable with the value of 1 if the operating cash flow is negative, and 0 otherwise
Other Corporate Governance Mechanism		
Big4	–	Audit firm size, measured by a dichotomous variable with the value of 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise
Blockholder	–	Ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares
Fundamental Firm Characteristics and Firm's Earnings Process		
Size	–	Firm size, defined as natural logarithm of revenues
|NI|	+	Absolute net income, defined as absolute net income scaled by total assets
|CF|	+	Absolute operating cash flow, defined as absolute operating cash flow scaled by total assets
Additional Control Variable for Audit Committee Characteristics Models		
IMR	?	Inverse Mills ratio, estimated as $\varphi(z)/\Phi(z)$, where z is the fitted value of the following probit regression index function for audit committee existence (non-linear combination of the first stage regressors of the Heckman procedure), φ is the density function for standard normal distribution, and Φ is the cumulative density function for standard normal distribution: $Prob[AC\_exist = 1] = Probit\ (\beta_0 + \beta_1 LEV + \beta_2\ Blockholder + \beta_3\ Size + \beta_4\ BoardSize + \beta_5\ OPRisk + \beta_{6-11}\ XControls + \varepsilon)\ (see\ Eq.\ 6)$
Additional Variables for first stage of Heckman procedure on Audit Committee Existence		
BoardSize	+	Size of the supervisory board despite of firm size (abnormal board size), measured as residuals from the univariate OLS regression of the number of members of the supervisory board on *Size*
OPRisk	+	Risk of the operation cycle and the generation of cash from operation, measured by [gross inventories + receivables]/total assets

ACexpert as a test variable, distinguishing whether or not an audit committee exhibit a financial expert or not:

$$|DA| = \beta_0 + \beta_1 ACexpert + control\ variables + \beta_x IMR + \varepsilon \qquad (3)$$

Further specification of the *ACexpert* variable is required, as a common definition of financial experts is lacking and definitions also vary between empirical studies.[8] Following legal commentary literature on paragraph 100 (5) AktG and 5.3.2 GCGC, financial expertise can be determined by the members' qualification as well as their experience (Hüffer [2012]). Ringleb et al. ([2014]) attribute financial expertise especially to having been previous or being currently CFOs, heads of accounting or internal revision, or CPAs. Based on these statements in legal commentary literature, the curriculum vitae of each audit committee member were reviewed to capture their financial expertise.[9]

To test the association between discretionary accruals and audit committee size (hypothesis H$_3$), we use both a discrete ordinal variable *ACsize,* which describes the size by number of members assigned to audit committee and *ACsize^2,* which is audit committee size squared, to capture the potentially non-linear relationship (quadratic model):

$$|DA| = \beta_0 + \beta_1 ACsize + \beta_1 ACsize^2 + control\,variables + \beta_x IMR + \varepsilon \qquad (4)$$

A quadratic model to test for non-linear effects allows size to have a gradual impact, rather than a fixed effect that begins and ends abruptly in discrete intervals. This approach enables us to estimate the "effective" audit committee size, which results in the lowest level of discretionary accruals.

The association between discretionary accruals and audit committee meeting frequency (hypothesis H$_4$) is also estimated by using a quadratic model including *ACmeet* as a discrete ordinal variable, representing the number of meetings held by the audit committee during the fiscal year (personal meetings as well as telephone conferences) and *ACmeet^2* as audit committee meetings squared.

$$|DA| = \beta_0 + \beta_1 ACmeet + \beta_2 ACmeet^2 + control\,variables + \beta_x IMR + \varepsilon \quad (5)$$

The inverse Mills ratio (*IMR*) is included in the models for audit committee characteristics, to correct for potential self-selection bias. Such bias might result from the fact that sub-samples for audit committee characteristics contain only observations of firms with an audit committee. These committees are voluntary and therefore, their existence is intentionally determined by firms. Hence, the sub-samples for these regressions are non-randomly selected, which creates an endogeneity issue, due to potential omitted variables. The inverse Mills ratio is obtained from an estimated Heckman first-stage regression model explaining the voluntary

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[8] The financial expertise of the audit committee has to be disclosed as part of the GCGC declaration. However, due to a lack of definition of financial expertise, firms have a broad scope in defining financial expertise and might avoid negative declarations. Therefore, information derived from the GCGC declaration is not sufficiently reliable. Most of the empirical studies focus directly on the committee members' specific knowledge of financial accounting in defining a financial expert. Some of these studies extend the definition of expertise on management expertise, to specific knowledge in auditing or juridical knowhow.

[9] In a similar way, Velte and Stiglbauer ([2011]) used survey and internet research with respect to curriculum vitae of supervisory board members to gather data on financial expertise.

audit committee existence (see Sect. 4.3.1 for a model description). Based on the regression results, it is defined as a non-linear combination of the first-stage regressors.

Control Variables

Control variables include management incentives for earnings management, other opposing corporate governance mechanisms apart from audit committees, as well as fundamental firm characteristics and variables controlling for the firm's inherent earnings and accruals process that have been shown by the related literature to influence discretionary accruals.

Earnings Management Incentives

Prior studies show that the level of earnings management is positively related to firm growth (e. g. Menon and Williams 2004; Gul et al. 2009), so that the model controls for growth (*Growth*).

Three variables are included in the model to describe earnings management incentives induced by the firm's financial situation. DeFond and Jiambalvo (1994), Davidson et al. (2005) and Piot and Janin (2007) argue that firms with more debt have greater incentives for earnings management, due to debt covenant constraints. Therefore, we add leverage (*Lev*) into the model. Dechow and Dichev (2002), Baxter and Cotter (2009), and Dhaliwal et al. (2010) find that negative net income results in more earnings management. Negative net income could create an incentive for big bath accounting. Hence, we include the variable *Loss* in our model. Similarly, a negative operating cash flow (*NegCF*) might result in more discretionary accruals (Bédard et al. 2004); either negative accruals based on an incentive for big bath accounting or positive accruals to mask poor performance.

Other Corporate Governance Mechanisms

It is proposed theoretically by DeAngelo (1981) and empirically supported by U.S. studies, that Big 4 auditors perform higher audit quality (Frankel et al. 2002; Piot and Janin 2007; Baxter and Cotter 2009; Ghosh et al. 2010). However, European studies often do not find significant differences between Big 4 and non-Big 4 audit firms, which may be caused simply by a less risky audit environment (Vander Bauwhede and Willekens 2004; Svanström 2013). Nevertheless, we add an indicator variable for audit firm size into our model to control for potential size-induced differences in earnings management (*Big 4*).

We control for ownership structure by including *Blockholder*. Prior empirical studies find a negative association between earnings management and concentrated ownership, which is explained by their better position to monitor the financial reporting process.

Fundamental Firm Characteristics and Firm's Earnings Process

Several studies show that firm size is inversely related to discretionary accruals (e. g. Dechow and Dichev 2002; Ghosh et al. 2010). Larger firms have more stable and predictable operations and are usually more diversified, with various business activities, than smaller firms, which results in lower errors in estimated accruals and which is reflected in lower discretionary accruals. Therefore, we control for firm size (*Size*).

We include two variables which control for firm's inherent accruals and earnings process, respectively, the absolute value of net income (|*NI*|) and of operating cash flow (|*CF*|). Prior studies show that the level of discretionary accruals is associated with both variables (Dechow et al. 1995; Dechow and Dichev 2002; Klein 2002a; Bédard et al. 2004; Kothari et al. 2005). In other words, controlling for these variables reduces bias in the estimation of discretionary accruals resulting from a positive correlation of the measurement error in discretionary accruals with the current level of earnings and operating cash flow.

4 Results

4.1 Descriptive Statistics

Table 3 provides descriptive statistics for earnings management variables (Panel A), audit committee variables (Panel B), and control variables (Panel C).

Regarding the discretionary accruals, Panel A shows mean (median) |*DA*| of 0.047 (0.032), which indicates that the total amount of earnings management is 4.7 (3.2) percent of lagged total assets. The sample firms engage on average in income-decreasing earnings management, as the mean (median) of *DA* equals –0.8 (–0.8) percent of lagged total assets. Looking at the variables of interest in Panel B, 47% of the firm-year observations include firms that have established an audit committee (*ACexist*). 60% of the audit committees consist of at least one financial expert. Audit committee size (*ACsize*) has a mean (median) value of 3.7 (3), but the size ranges from 2 to 8 members (see Fig. 1). Considering the first and the third quartile, 50% or more observations have 3 to 4 members. Audit committees meet (*ACmeet*) on average (median) 3.2 (3) times per fiscal year. However, additionally regarding Fig. 1, the range is relatively high, as 0 and 12 meetings are also observed. Nevertheless, 50% or more observations have 2 to 4 meetings.

4.2 Univariate Analyses

We perform mean and median tests with the binary variables *ACexist* and *ACexpert* and |*DA*|, respectively, to test for differences in earnings management, depending on audit committee existence and on the presence of financial expertise. Table 4 shows the results.

Mean (median) values of |*DA*| are significantly lower ($p < 0.01$) when an audit committee exists (*ACexist* = 1), compared to firms without audit committees

Table 3 Descriptive statistics

Panel A: Earnings Management Variables

Variable	n	Mean	Std. dev	Q 1	Median	Q 3
DA	1462	−0.008	0.068	−0.041	−0.008	0.023
|DA|	1462	0.047	0.050	0.015	0.032	0.060

Panel B: Audit Committee Variables

Variable	n	Mean	Std. dev	Q 1	Median	Q 3
ACexist	1462	0.471	–	–	–	–
ACexpert	476	0.600	–	–	–	–
ACsize	509	3.720	1.100	3	3	4
ACmeet	656	3.160	1.831	2	3	4

Panel C: Control Variables

| Variable	n	Mean	Std. dev	Q 1	Median	Q 3
Growth	1462	0.121	0.428	−0.038	0.044	0.155
Lev	1462	2.003	4.331	0.612	1.280	2.158
Loss	1462	0.244	–	–	–	–
NegCF	1462	0.154	–	–	–	–
Big4	1462	0.598	–	–	–	–
Blockholder	1462	0.411	0.290	0.152	0.423	0.634
Size	1462	5.348	2.140	3.812	5.120	6.760
|NI|	1462	0.089	0.128	0.029	0.055	0.096
|CF|	1462	0.112	0.100	0.055	0.089	0.137

The sample period encompasses years 2005–2009. DA is the signed value of estimated discretionary accruals scaled by lagged total assets. |DA| is the absolute value of estimated discretionary accruals scaled by lagged total assets. ACexist is the audit committee existence, coded 1 if the firm has an audit committee, and 0 otherwise. ACexpert is the financial expertise of the audit committee, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise. ACsize is the audit committee size, defined as the number of audit committee members. ACmeet is audit committee meetings, defined as the number of audit committee meetings per fiscal year. Growth is the growth rate, defined as change in total assets compared to the previous fiscal year. Lev is the leverage ratio, defined as total liabilities divided by common equity. Loss is the negative net income, coded 1 if the net income is negative, and 0 otherwise. NegCF is the negative operating cash flow, coded 1 if the operating cash flow is negative, and 0 otherwise. Big4 is the audit firm size, coded 1 if the consolidated financial statement was audited by a Big 4 audit firm, and 0 otherwise. Blockholder is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. Size is the firm size, defined as natural logarithm of revenues. |NI| is the absolute net income scaled by total assets. |CF| is the absolute operating cash flow scaled by total assets

(ACexist = 0). Furthermore, mean (median) values of |DA| are significantly lower ($p < 0.05$) when audit committees include at least one financial expert (ACexpert = 1), compared to audit committees without a financial expert (ACexpert = 0).

We depict the relationship between earnings management and audit committee size and audit committee meetings, respectively in Fig. 1.

Fig. 1 indicates that discretionary accruals decrease markedly if audit committee size, as well as the number of audit committee meetings, increases. Following the graph of audit committee size, the lowest level of earnings management is located at approximately 5 members. However, the graph does not increase markedly after this turning point, indicating that larger differences only seem to exist between "small"-

Fig. 1 Univariate analyses. (|*DA*| is the absolute value of estimated discretionary accruals scaled by lagged total assets. *ACsize* is the audit committee size, defined as the number of audit committee members. *ACmeet* is audit committee meetings, defined as the number of audit committee meetings per fiscal year)
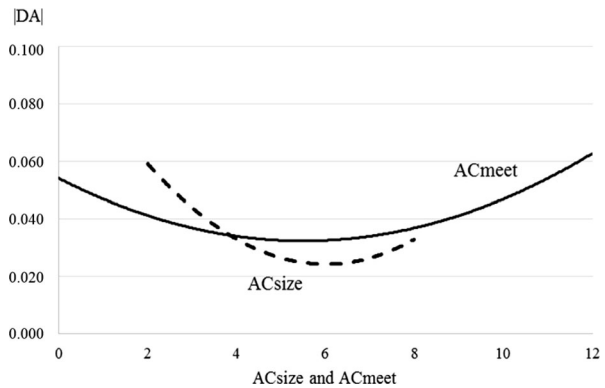
and "medium"-sized audit committees, and only smaller differences seem to exist between "medium"- and "large"-sized audit committees. Following the graph of audit committee meetings, the lowest level of earnings management is at approximately 5 meetings, and earnings management increases again after this turning point.

Table 5 shows the results of the correlation analysis.

Regarding the correlation coefficients of the control variables, we do not find any indications that our multivariate regression results are biased by multicollinearity.

4.3 Multivariate Analysis

4.3.1 Audit Committee Existence

The results of the OLS regression using *ACexist* as the test variable and |*DA*| as the dependent variable are presented in Table 6 (testing hypothesis H_1).

The coefficient of *ACexist* (–0.005) is significantly negative at the 5% level. This indicates that firms with an audit committee engage significantly less in earnings management than firms without one.

Despite the negative association between the existence of an audit committee and earnings management, it is not possible to differentiate between whether audit committees influence earnings management negatively, or whether firms with high financial reporting quality are more likely to have audit committees. The existence of an audit committee depends on agency and governance factors that are also relevant for a firm's earnings management behavior. In other words, the existence of an audit committee might be endogenous to the firm's earnings management behavior. To consider potential endogeneity, we use a two-stage least squared regression (2SLS).[10] The first stage is a probit regression in which the dichotomous variable *ACexist* is regressed on factors explaining the existence of an audit committee and all other exogenous variables involved as control variables in the discretionary accruals

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[10] We conduct the Hausman test, using the residuals of the first-stage regression as an additional control variable in the original one-stage regression model. The results indicate that there are endogeneity issues, as the coefficient of this control variable is significant.

Table 4 Univariate analyses – mean and median tests

Variable	|DA|	
	Mean	Median
ACexist = 0	0.052	0.035
ACexist = 1	0.041***	0.029***
ACexpert = 0	0.049	0.038
ACexpert = 1	0.035**	0.026**

*, **, and *** denote significance (asymptotic significance) at 10%, 5%, and 1% level, respectively (*p*-values are one-tailed when direction is as predicted, and two-tailed otherwise)

|DA| is the absolute value of estimated discretionary accruals scaled by lagged total assets. *ACexist* is the audit committee existence, coded 1 if the firm has an audit committee, and 0 otherwise. *ACexpert* is the financial expertise of the audit committe, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise

model (Eq. 2) (Klein 2002b; Piot 2004; Piot and Janin 2007). Factors explaining the existence of an audit committee are derived from the literature with at least some two-tier board of directors background (e. g., Piot 2004; Piot and Janin 2007) and contain the variables *Lev, Blockholder, Size, BoardSize*, and *OPRisk. Lev* measures a firm's leverage. The motivation to form audit committees may increase with leverage in order to control more strongly for the fulfillment of debt covenant constraints. In this context, an audit committee can also be forced by debtholders or may signal stronger monitoring to debtholders, which can result in lower risk premiums. *Blockholder* controls for a concentrated ownership structure. With a similar line of argumentation as in the context of debtholders, larger shareholders are more likely to demand audit committees as they are a well-established part of international good corporate governance. *Size* measures firm size, with larger firms being subjected to stronger public control than smaller firms. This creates a threat of reputation loss, which may result in an increased demand for intensified monitoring and in a higher incentive to comply with corporate governance principles. Moreover, supervisory board size depends on firm size, and the implementation of an audit committee is mostly associated with additional fixed costs, which increases the benefit gained from audit committees for larger firms (Pincus et al. 1989). *BoardSize* measures the size of the supervisory board quite apart from firm size (abnormal board size; residuals from the univariate OLS regression of the number of members of the supervisory board on *Size*). Comparably larger supervisory boards are more likely to act less efficiently, which may enhance firms' motivation to form specialized committees as sub-groups to delegate their duties (Piot and Janin 2007). *OPRisk* captures the risk of the operation cycle and the generation of cash from operations and is measured by [gross inventories + receivables]/total assets. A larger proportion of inventories and receivables indicates longer cash-generation processes and higher working capital requirements (Simunic 1980). Higher operational risk may increase the demand for additional monitoring devices (Piot 2004). The probit function of the first stage of the Heckman procedure is structured as follows:

Table 5 Univariate analyses – Pearson's (above the diagonal) and Spearman's (beyond the diagonal) correlation matrix

	IDAI	ACexist	ACsize	ACexpert	ACmeet	Growth	Lev	Loss	NegCF	Big4	Block-holder	Size	INII	ICFI
IDAI	–	-0.115***	-0.230***	-0.071**	-0.105***	0.090***	0.084***	0.145***	0.214***	-0.037*	0.023	-0.200***	0.198***	0.236***
ACexist	-0.085***	–	–	–	–	-0.018	0.007	-0.049	-0.056***	0.322***	-0.123***	0.507***	-0.099***	-0.079***
ACsize	-0.231***	–	–	–	0.245***	-0.117***	0.317***	-0.101**	-0.160***	0.129***	-0.087**	0.653***	-0.214***	-0.220***
ACexpert	-0.063	–	–	–	–	-0.018	-0.036	-0.089*	-0.150***	0.001	-0.030	0.152***	-0.053	-0.033
ACmeet	-0.129***	–	0.269***	0.045	–	0.007	0.160***	0.087*	0.026	0.169***	-0.053	0.322***	-0.055	-0.084**
Growth	0.029	-0.003	-0.074*	0.002	-0.049	–	-0.032	-0.180***	-0.117***	0.003	-0.088***	0.013	-0.158***	-0.092***
Lev	-0.068***	0.211***	0.498***	0.042	0.177***	-0.089***	–	0.111***	0.085***	-0.004	0.031	0.097***	0.012	-0.040
Loss	0.114***	-0.049*	-0.105***	-0.089*	0.056	-0.369***	0.086***	–	0.566***	0.001	0.025	-0.247***	0.204***	0.064***
NegCF	0.139***	-0.056***	-0.170***	-0.150***	0.018	-0.273***	-0.020	0.566***	–	-0.064**	0.005	-0.314***	0.305***	-0.023
Big4	-0.028	0.322***	0.109***	0.001	0.203***	-0.016	0.148***	0.001	-0.064**	–	-0.019	0.328***	-0.063**	-0.024
Block-holder	0.005	-0.122***	-0.113***	-0.032	-0.069*	-0.102***	-0.040	0.025	0.005	-0.017	–	-0.108***	0.028	0.022
Size	-0.181***	0.532***	0.707***	0.126***	0.389***	0.076***	0.487***	-0.240***	-0.302***	0.326***	-0.104***	–	-0.244***	-0.154***
INII	0.138***	-0.127***	-0.296***	-0.032	-0.092***	-0.040	-0.260***	0.336***	0.440***	-0.067***	0.023	-0.313***	–	0.714***
ICFI	0.171***	-0.043	-0.215***	0.014	-0.134***	0.112***	-0.249***	-0.148***	0.181***	-0.064***	0.027	-0.274***	0.533***	–

*, **, and *** denote significance at 10%, 5%, and 1% level, respectively (*p*-values are one-tailed when direction is as predicted, and two-tailed otherwise)

IDAI is the absolute value of estimated discretionary accruals scaled by lagged total assets. ACexist is the audit committee existence, coded 1 if the firm has an audit committee, and 0 otherwise. ACexpert is the financial expertise of the audit committee, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise. ACsize is the audit committee size, defined as the number of audit committee members. ACmeet is audit committee meetings, defined as the number of audit committee meetings per fiscal year. Growth is the growth rate, defined as change in total assets compared to the previous fiscal year. Lev is the leverage ratio, defined as total liabilities divided by common equity. Loss is the negative net income, coded 1 if the net income is negative, and 0 otherwise. NegCF is the negative operating cash flow, coded 1 if the operating cash flow is negative, and 0 otherwise. Big4 is the audit firm size, coded 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise. Blockholder is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. Size is the firm size, defined as natural logarithm of revenues. INII is the absolute net income scaled by total assets. ICFI is the absolute operating cash flow scaled by total assets.

Table 6 Regression results for absolute discretionary accruals (|DA|) on audit committee existence (ACexist) and control variables (OLS)

Variable	Predicted Sign	|DA|	
		β	t-Value
Intercept		0.038***	7.613
ACexist	–	–0.005**	–1.848
Growth	+	0.015***	5.243
Lev	+	0.001***	3.515
Loss	+	0.007**	1.957
NegCF	+	0.020***	4.586
Big4	–	0.003	1.112
Blockholder	–	0.002	0.371
Size	–	–0.002***	–2.654
|NI|	+	–0.030*	–1.893
|CF|	+	0.124***	4.586
Adjusted R²			0.120
F-statistic			20.949***
n			1462

*, **, and *** denote significance at 10%, 5%, and 1% level, respectively (p-values are one-tailed when direction is as predicted, and two-tailed otherwise).

Dependent variable is |DA| which is the absolute value of estimated discretionary accruals scaled by lagged total assets. *ACexist* is the audit committee existence, coded 1 if the firm has an audit committee, and 0 otherwise. *ACexpert* is the financial expertise of the audit committee, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise. *ACsize* is the audit committee size, defined as the number of audit committee members. *ACmeet* is audit committee meetings, defined as the number of audit committee meetings per fiscal year. *Growth* is the growth rate, defined as change in total assets compared to the previous fiscal year. *Lev* is the leverage ratio, defined as total liabilities divided by common equity. *Loss* is the negative net income, coded 1 if the net income is negative, and 0 otherwise. *NegCF* is the negative operating cash flow, coded 1 if the operating cash flow is negative, and 0 otherwise. *Big4* is the audit firm size, coded 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise. *Blockholder* is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. *Size* is the firm size, defined as natural logarithm of revenues. *|NI|* is the absolute net income scaled by total assets. *|CF|* is the absolute operating cash flow scaled by total assets.

$$\begin{aligned} Prob\left[AC\_exist = 1\right] = Probit(&\beta_0 + \beta_1 LEV + \beta_2 Blockholder + \\ &\beta_3 Size + \beta_4 BoardSize + \beta_5 OPRisk + \\ &\beta_{6-11} XControls) + \varepsilon \end{aligned} \quad (6)$$

where:
XControls = Growth, Loss, NegCF, Big4, |NI|, |CF|.

The predicted value of *ACexist* is an instrumental variable (*ACexist_Instr*), which is used as test variable instead of *ACexist* in our accruals model (second stage of Heckman procedure). *BoardSize* and *OPRisk* are not included as control variables in the second stage. *BoardSize* depends on statutory requirements, and abnormal board size does not have a direct impact on firms' earnings management behavior. *OPRisk* is not included in the second stage model, as discretionary accruals are already derived from a model which controls for accruals resulting from the firm's

Table 7 Regression results for absolute discretionary accruals (|DA|) on audit committee existence (ACexist) and control variables (2SLS)

Variable	Predicted Sign	1st Stage (ACexist)		Predicted Sign	2nd Stage (|DA|)	
		β	Wald		β	t-Value
Intercept	?	−5.409***	195.025	?	0.025***	3.959
ACexist_Instr		−	−	−	−0.003***	−3.392
Growth	?	−0.160	0.914	+	0.015***	5.124
Lev	+	−0.068**	4.013	+	0.001***	2.999
Loss	?	−0.007	0.001	+	0.007**	2.073
NegCF	?	0.196	0.634	+	0.022***	4.951
Big4	?	0.909***	37.557	−	0.006	0.195
Blockholder	+	0.939***	13.463	−	−0.001	−0.207
Size	+	0.900***	221.796	−	−0.001**	−2.195
|NI|	?	−0.687	0.584	+	−0.033**	−2.091
|CF|	?	0.951	0.844	+	0.129***	7.024
BoardSize	+	0.411***	167.476		−	−
OPRisk	+	1.976***	25.208		−	−
Pseudo R²/ Adj. R²		0.547			0.125	
χ-square/ F-statistic		770.886***			21.873***	
n		1462			1462	

*, **, and *** denote significance at 10%, 5%, and 1% level, respectively (p-values are one-tailed when direction is as predicted, and two-tailed otherwise)

Dependent variable is |DA| which is the absolute value of estimated discretionary accruals scaled by lagged total assets. ACexist is the audit committee existence, coded 1 if the firm has an audit committee, and 0 otherwise. ACexpert is the financial expertise of the audit committee, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise. ACsize is the audit committee size, defined as the number of audit committee members. ACmeet is audit committee meetings, defined as the number of audit committee meetings per fiscal year. Growth is the growth rate, defined as change in total assets compared to the previous fiscal year. Lev is the leverage ratio, defined as total liabilities divided by common equity. Loss is the negative net income, coded 1 if the net income is negative, and 0 otherwise. NegCF is the negative operating cash flow, coded 1 if the operating cash flow is negative, and 0 otherwise. Big4 is the audit firm size, coded 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise. Blockholder is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. Size is the firm size, defined as natural logarithm of revenues. |NI| is the absolute net income scaled by total assets. |CF| is the absolute operating cash flow scaled by total assets. BoardSize is the size of the supervisory board despite of firm size (abnormal board size). OPRisk is the risk of the operation cycle, measured by [gross inventories + receivables]/total assets.

operational business. Furthermore, *OPRisk* also partly expresses the firm's inherent accruals and earnings process which is already captured by *|CF|* and *|NI|* and, earnings management incentives resulting from lower liquidity are also captured by *NegCF* in the second-stage regression. We therefore estimate a 2SLS approach based on exclusion restrictions.[11]

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[11] This procedure is also recommended by Larcker and Rusticus (2007); Tucker (2010) and Lennox et al. (2012), who highlight problems based on selection models and derive suggestions for implementing these models.

The results of both stages are reported in Table 7. Beside *Lev*, all of the variables explaining the existence of audit committees (first stage) are significant at the 1% level in the expected direction. The second stage regression shows a negative and significant coefficient of *ACexist_Instr* (–0.003, $p < 0.01$). Hence, the results remain unchanged when addressing endogeneity concerns by a 2SLS approach and hypothesis H_1 is confirmed, as the existence of an audit committee is related to lower levels of earnings management. Beside *Big 4*, |*NI*| and *Blockholder*, all other control variables are significant in the expected direction.

4.3.2 Audit Committee Characteristics

To test the relationship between the defined audit committee characteristics and earnings management (hypotheses H_2–H_4), we use a subsample including only firm-year observations with existing audit committees. Table 8 provides the results of the OLS regressions.

Column one shows the results using *ACexpert* as the test variable (testing hypothesis H_2). The coefficient of *ACexpert* is negative (–0.006) and significant at 5% level. This result suggests that earnings management is lower for audit committees, with at least one financial expert, compared to audit committees without financial expertise. Therefore, hypothesis H_2 is confirmed. Financial expertise, as one of the main composition factors of audit committees, influences the committee effectiveness.

Column two shows the results using *ACsize* and *ACsize*^{2} as test variables (testing hypothesis H_3). Both coefficients of *ACsize* and *ACsize*^{2} are in the expected directions. The coefficient of *ACsize* is negative (–0.010) and the coefficient of *ACsize*^{2} is positive (0.001). However, both coefficients are insignificant, indicating that audit committee size does not influence the degree of earnings management. Therefore, H_3 is not confirmed. Audit committee size per se seems to be less important than the composition of the committee, especially the inclusion of members with financial expertise in the committee.

Column three shows the results using *ACmeet* and *ACmeet*^{2} as test variables (testing H_4). The coefficient of *ACmeet* is negative and significant (–0.004, $p < 0.05$), and the coefficient of *ACmeet*^{2} is positive and significant (0.001, $p < 0.05$). The "effective" number of audit committee members is determined at the minimum of the curve, reflecting the lowest level of discretionary accruals. Setting the first derivative of the regression function to zero results in an optimal value of 4.8 for audit committee meetings. The value is within the range recommended in the literature and in line with our argumentation yielding 4 to 6 meetings per fiscal year as a sufficient frequency to ensure the quality of financial and accounting processes when audit committees are functioning efficiently. The results also confirm the expected non-linear relationship between the meeting frequency and earnings management (hypotheses H_4). Hence, this result indicates that earnings management is higher for audit committees that seldom meet and for audit committees with a high number of meetings.

The coefficients of the inverse Mills ratio (*IMR*) are significant at the 1% level in all three models, confirming the importance of correcting for sample selection bias.

Table 8 Regression results for absolute discretionary accruals (|DA|) on financial expert (ACexpert), audit committee size (ACsize), and on audit committee meetings (ACmeet), respectively, and control variables (OLS)

Variable	Predicted Sign	|DA|		|DA|		|DA|	
		β	t-Value	β	t-Value	β	t-Value
Intercept	?	0.005	0.512	0.037*	1.700	0.034***	3.550
ACexpert	–	–0.006**	–2.099	–	–	–	–
ACsize	–	–	–	–0.010	–1.150	–	–
ACsize²	+	–	–	0.001	1.099	–	–
ACmeet	–	–	–	–	–	–0.004**	–2.067
ACmeet²	+	–	–	–	–	0.001**	1.927
Growth	+	0.018***	5.100	0.018***	5.074	0.017***	4.983
Lev	+	0.001	–0.526	0.001	–0.359	0.001	–0.195
Loss	+	0.011***	2.394	0.008**	1.814	0.007**	1.823
NegCF	+	0.006	1.008	0.018***	3.307	0.011**	2.166
Big4	–	0.010	2.757	0.008	2.234	0.004	1.256
Blockholder	–	–0.006	–1.256	–0.009**	–1.876	–0.006*	–1.470
Size	–	0.002*	1.545	–0.001*	–0.404	–0.001*	–0.445
|NI|	+	–0.065***	–2.855	–0.064***	–2.775	–0.053**	–2.411
|CF|	+	0.059**	2.284	0.051*	1.899	0.059**	2.314
IMR	?	0.030***	6.862	0.021***	4.145	0.016***	3.921
Adjusted R²		0.164		0.160		0.117	
F-statistic		9.498		9.038***		8.212***	
n		476		509		656	

*, **, and *** denote significance at 10%, 5%, and 1% level, respectively (*p*-values are one-tailed when direction is as predicted, and two-tailed otherwise)

Dependent variable is *|DA|* which is the absolute value of estimated discretionary accruals scaled by lagged total assets. *ACexpert* is the financial expertise of the audit committee, coded 1 if the audit committee consists of at least one financial expert, and 0 otherwise. *ACsize* is the audit committee size, defined as the number of audit committee members. $ACsize^2$ is the audit committee size squared. *ACmeet* are the audit committee meetings, defined as the number of audit committee meetings per year. $ACmeet^2$ is the audit committee meetings squared. *Growth* is the growth rate, defined as change in total assets compared to the previous year. *Lev* is the leverage ratio, defined as total liabilities divided by common equity. *Loss* is the negative net income, measured by a dichotomous variable with the value of 1 if the net income is negative, and 0 otherwise. *NegCF* is the negative operating cash flow, measured by a dichotomous variable with the value of 1 if the operating cash flow is negative and 0 otherwise. *Big4* is the audit firm size, measured by a dichotomous variable with the value of 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise. *Blockholder* is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. *Size* is the firm size, defined as natural logarithm of revenues. *|NI|* is the absolute net income, defined as absolute net income scaled by total assets. *|CF|* is the absolute operating cash flow, defined as absolute operating cash flow scaled by total assets. *IMR* is Inverse Mills Ratio, estimated as $\varphi(z)/\Phi(z)$, where z is the fitted value of the following probit regression index function for audit committee existence (non-linear combination of the first stage regressors of the Heckman procedure), φ is the density function for standard normal distribution, and Φ is the cumulative density function for standard normal distribution: Prob[AC_exist = 1] = Probit $(\beta_0 + \beta_1 LEV + \beta_2 Blockholder + \beta_3 Size + \beta_4 BoardSize + \beta_5 OPRisk + \beta_{6-11} XControls + \varepsilon)$ (see Eq. 7).

5 Additional Analysis of Audit Committee Formation

In order to further address the endogeneity issue raised in Sect. 4.3.1, we analyze the effect of audit committee formation on earnings management. As stated by Baxter and Cotter (2009), analyzing the effect of audit committee formation is a more direct test of the audit committee's influence on earnings management than analyzing audit committee existence. It enables estimating the change in earnings management subsequent to the voluntary formation of an audit committee. We apply a differences-in-differences approach that compares changes in discretionary accruals of a treatment group that forms audit committees during the investigation period, to changes in discretionary accruals of a matched control group of firms that entirely have audit committees during the investigation period.[12] The treatment group consists of 22 firms identified in the final sample for audit committee existence (see Sect. 3.1) that formed an audit committee during the investigation period. We use three different matching procedures: size matching, size and performance matching, and propensity score matching, to generate the control group of 22 firms each. This procedure results in three audit committee formation samples, which consist of 88 firm-year observations each.

Size matching is commonly used in the literature (e. g., Ernstberger et al. 2012; Vander Bauwhede et al. 2003; Abbott 2000; Beasley 1996), since it ensures high homogeneity between treatment and control group. The sample chooses control firms that are most similar in terms of *Size*. A size- and performance-matched control sample is chosen, as firm performance might also be an important homogeneity criterion. The sample only requires firm size to be within a range of ±30%[13] and additionally chooses the control firms that are most similar in terms of firm net income scaled by total assets. Both matching procedures require observations of the control group to be in the same industry and fiscal year as the treatment group observations. The propensity score matching is based on the probability that firms have an audit committee. We calculate the propensity score by using a probit regression in which the dichotomous variable *ACexist* is regressed on the factors described in Sect. 4.3.1 (2SLS approach), which explain the existence of an audit committee. Control firms are chosen by so-called nearest neighbor matching.

The differences-in-differences design is implemented with the following regression model:

$$|DA| = \beta_0 + \beta_1 ACformation + \beta_2 Post + \beta_3 ACformation * Post + control\, variables + \varepsilon \tag{7}$$

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[12] We only choose firms that entirely have an audit committee as control firms to better account for potential self-selection issues.

[13] The range of ±30% size difference is used in several matched sample approaches. However, matching only within a range of ±30% results in several suitable firms, which leaves scope of action to choose the "right" one. To overcome this problem, some studies choose firms randomly out of the pool of potentially suitable ones (Abbott 2000; Beasley 1996). Instead, following the studies of Myers et al. (2007) and Louis (2004), we use an additional criterion to select the control firms.

Table 9 Regression results of the differences-in-differences model for absolute discretionary accruals (|DA|) on audit committee formation and control variables (OLS)

Variable	Predicted Sign	Size Matched |DA|		Performance Matched |DA|		Propensity Score |DA|	
		β	t-Value	β	t-Value	β	t-Value
Intercept	?	0.028	0.637	0.061**	2.460	0.049***	2.701
ACformation	?	0.005	0.404	0.002	0.132	0.009	0.902
Post	?	0.032**	2.546	0.020	1.641	0.014	1.383
ACformation*Post	–	–0.037**	–2.389	–0.025*	–1.433	–0.017*	–2.329
Growth	+	0.022***	2.973	0.019***	2.329	0.019***	2.883
Lev	+	0.008*	1.335	–0.001	–0.287	–0.001	–0.023
Loss	+	–0.016	–1.127	–0.016	–1.122	–0.021**	–1.897
NegCF	+	0.008	0.404	0.022	0.943	0.019	1.216
Big4	–	0.006	0.289	0.010	0.916	0.008	0.821
Blockholder	–	–0.007	–0.505	–0.001	0.065	–0.001	–0.665
Size	–	–0.002	–0.675	–0.003	–1.117	–0.002	–0.831
|NI|	+	0.204*	1.440	0.104	0.716	0.169*	1.507
|CF|	+	–0.118	–1.005	–0.149	–1.357	–0.198**	–2.244
Adjusted R²		0.126		0.104		0.169	
F-statistic		2.045**		1.844*		2.473***	
n		88		88		88	

*, **, and *** denote significance at 10%, 5%, and 1% level, respectively (p-values are one-tailed when direction is as predicted, and two-tailed otherwise)

Dependent variable is |DA| which is the absolute value of estimated discretionary accruals scaled by lagged total. *ACforamtion* is treatment group group membership variable, coded 1 if the firm has formed an audit committee during the investigation period and therefore belongs to the treatment group, and o if the firm entirely has an audit committee during the investigation period and therefore belongs to the control group. *Post* is the post formation year, coded 1 in cases of the post-formation year, and 0 in case of the pre-formation year. *Growth* is the growth rate, defined as change in total assets compared to the previous year. *Lev* is the leverage ratio, defined as total liabilities divided by common equity. *Loss* is the negative net income, measured by a dichotomous variable with the value of 1 if the net income is negative, and 0 otherwise. *NegCF* is the negative operating cash flow, measured by a dichotomous variable with the value of 1 if the operating cash flow is negative and 0 otherwise. *Big4* is the audit firm size, measured by a dichotomous variable with the value of 1 if the consolidated financial statement was audited by a Big4 audit firm, and 0 otherwise. *Blockholder* is the ownership structure, measured as the percentage of shares held by investors with an individual shareholding of more than 5% of total shares. *Size* is the firm size, defined as natural logarithm of revenues. *|NI|* is the absolute net income, defined as absolute net income scaled by total assets. *|CF|* is the absolute operating cash flow, defined as absolute operating cash flow scaled by total assets

where

ACformation =   Treatment group membership (dichotomous variable), coded 1 if the firm formed an audit committee during the investigation period and therefore belongs to the treatment group, and 0 if the firm entirely has an audit committee during the investigation period and therefore belongs to the control group

Post =   Post-formation year (dichotomous variable), coded 1 for the post-formation year and 0 for the pre-formation year

Control variables =   Vector of control variables as defined in Sect. 3.3

The variable *ACformation* controls for differences in the level of earnings management between treatment and control group observations, whereas *Post* controls for changes between pre-formation and post-formation year. The variable of interest is the interaction term *ACformation*Post*, as its coefficient β_3 indicates whether the formation of an audit committee influences the level of earnings management.

Table 9 shows the regression results. With respect to the size-matched control sample, the coefficient of *ACformation*Post* (–0.037) is significantly negative at the 5% level. This means that earnings management decreases significantly after the formation of an audit committee. The same conclusion can be drawn from the coefficient of the size- and performance-matched control sample (–0.025, $p < 0.1$) and the coefficient of the propensity-score-matched control sample (–0.017, $p < 0.1$). Hence, the results are robust to changes in the control sample.

As an additional robustness check, a regression using only the treatment group (i. e., a differences approach) is performed. The result remains stable, as the coefficient (–0.017) is significantly negative at the 5% level.

6 Robustness Checks

We conduct several additional tests to verify the robustness of our results.

6.1 Signed Accruals

Besides using the absolute (unsigned) value of discretionary accruals |*DA*|, we also use signed discretionary accruals (*DA⁺* and *DA⁻*) as dependent variables, to test for separate impacts of audit committee existence and characteristics on income-increasing (*DA⁺*) and income-decreasing (DA⁻) earnings management. Therefore, we split the sample into two sub-samples: positive (DA > 0) and absolute values of negative (DA < 0) discretionary accruals and re-estimate models (2) to (6) with each sub-sample. The results for audit committee existence, as well as for audit committee characteristics, do differ between both sub-samples and remain unchanged compared to our main results. As a concluding remark from this set of robustness tests, we find that the existence of audit committees, financial expertise and a sufficient number of audit committee meetings, result in lower income-increasing, as well as income-decreasing earnings management. The results for audit committee size remain insignificant for both types of earnings management.

6.2 Alternative Accrual-based Earnings Management Specification

We use the cross sectional version of the Dechow and Dichev (2002) model as an alternative approach to Jones-based discretionary accruals models to measure earnings management.[14]

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[14] While Jones-based (1991) models are empirically derived, the Dechow/Dichev model is based on an analytical fundament.

$$DWCA_t =$$
$$WCA_t - [\beta_0 1/A_{t-1} + \beta_1 CFO_{t-1}/A_{t-1} + \beta_2 CFO_t/A_{t-1} + \beta_3 CFO_{t+1}/A_{t-1}] \quad (8)$$

We rerun the models for audit committee existence and audit committee characteristics (models (3) to (6)) by using the absolute values of discretionary working capital accruals $|DWCA_t|$ instead of the previously used $|DA_t|$ as the dependent variable. The results for audit committee existence, as well as for audit committee characteristics, remain unchanged by this variation in discretionary accruals measure and therefore support the results of the main analysis.

6.3 Additional Test of Abnormal Audit Committee Characteristics

Firm-size bias is a crucial point for analyzing the corporate governance aspects. We included firm size (*Size*) as a control variable in the main tests. However, this cannot completely rule out the possibility that the influence of audit committee size and the number of meetings on earnings management is biased by differences between smaller and larger firms. To control more effectively for potential firm-size bias, we test the impact of abnormal audit committee characteristics on discretionary accruals. We calculate abnormal audit committee size (*abnACsize*) and an abnormal number of meetings (*abnACmeet*) as the residuals from a regression of each audit committee characteristic on firm size and re-estimate the main regression models (4) and (5). In order to interpret the direction of the coefficients and to draw clear inferences from these tests, two sample restrictions are required. Based on the results for audit committee meetings of the main analysis, with an optimum of the squared regression for audit committee meetings of 4.8, we reduce the sample for *abnACmeet* to firm-year observations with one to five audit committee meetings ($n = 589$). In this sub-sample, an abnormally low number of meetings is expected to be associated with a higher level of earnings management, whereas an abnormally high number is expected to reduce earnings management. With respect to audit committee size, we limit our sample to a maximum size of six members, based on univariate results, as the squared regression did not yield a significant optimum size ($n = 505$).

$$|DA| = \beta_0 + \beta_1 abnACsize + control\,variables + \beta_x IMR + \varepsilon \quad (9)$$
$$|DA| = \beta_0 + \beta_1 abnACmeet + control\,variables + \beta_x IMR + \varepsilon \quad (10)$$

The results of these size-adjusted models support our main results, as we find no significant association between *abnACsize* and discretionary accruals, and because we find that an abnormally higher (lower) meeting frequency is associated with lower (higher) earnings management, within the range of 1 to an optimum of 5 meetings per year.

6.4 Year and Industry Fixed Effects

In our main analysis, we do not control separately for year and industry fixed effects, as we derive discretionary accruals from a model estimated separately for each industry-year. This procedure itself controls for differing levels and a dispersion of

accruals per industry-year and its additional inclusion as control variable therefore is somehow argumentatively redundant. Nevertheless, we re-estimate the models (2) to (6) including year and industry dummies to cover some latent industry-year-specific level differences. The results remain unchanged compared to the main results for audit committee existence and for audit committee characteristics.

7 Conclusion

The study provides evidence on the relationship between audit committees and earnings management in the German two-tier board system, with its voluntary audit committee establishment. We investigate whether (1) the existence and formation of an audit committee is associated to less earnings management and (2) specific audit committee characteristics enhance committee effectiveness. Based on a sample of 1462 firm-year observations from 401 firms listed on the regulated market of the Frankfurt stock exchange (CDAX), we find evidence that earnings management is lower if firms have an audit committee. Furthermore, we find that the level of earnings management decreases in the first year after audit committee formation, compared to the pre-formation year.

Based on these results, there is evidence that audit committee effectiveness can be enhanced further if the committee includes financial experts and if the committee meets regularly. Financial expertise is important to independently assessing financial issues presented to the audit committee. The results show that earnings management is lower when at least one audit committee member has financial expertise. Audit committee meetings represent the committee's activity. A sufficient amount of meetings indicates that the effort devoted to monitoring management is substantial. The results indicate that 4–5 meetings per year seem to represent an effective number of meetings, in order to reduce the level of earnings management. We further analyzed the impact of audit committee size on earnings management and expected that larger committees are better able to fulfill their duties and to cope with the complexity of corporate structure, but that these positive effects decline when committees become too large. However, we do not find evidence that audit committee size is related to earnings management, which implies that size per se is less important than the expertise of its members.

Our findings have implications for regulators, as audit committees seem to represent an effective corporate governance feature, also in the German two-tier system. Therefore, the regulator should discuss whether an obligation to form audit committees can further improve corporate governance (at least when firms have a certain size) or whether the current regulation sufficiently ensures the benefits of audit committees. The results are also relevant for firms seeking to improve their corporate governance in terms of (reliable) financial reporting. Besides implementing an audit committee, they should focus on an effective committee composition and a sufficiently high level of activity.

The study is subject to a number of limitations, most of which suggest the need for future research. First, although we control for endogeneity, we cannot fully rule out the possibility that our findings are driven by the latent decision-making pro-

cess to establish an audit committee. To further rule out self-selection bias, future research could focus on a comparable setting in which audit committee formation is imposed exogenously as a mandatory requirement for certain firms, and in which a subset of firms is exempt from that regulation. Second, because it is not possible to directly measure the effectiveness of audit committees, earnings management is used as a proxy. Our study focuses on accrual-based earnings management. The determination of discretionary accruals is subject to measurement errors. The study takes various precautions to limit the effects of these errors, by using a Jones-based model version with a stronger focus on firm performance and the Dechow/Dichev-model as an alternative model to test for accruals quality. We are also aware that accrual-based earnings management only partly captures a firm's level of earnings management and that a lower level of accrual-based earnings management might result in a higher level of real earnings management, which would leave overall earnings management unchanged. Prior empirical research (e. g. Chi et al. 2011; Zang 2012) find evidence that this trade-off between accrual-based earnings management and real earnings management actually occurs. We further note that to the extent that real activities earnings management indicates an inefficient use of resources and greater managerial myopia,[15] criticizing and preventing this falls into the mandate of the supervisory board and hence, of the audit committee. Third, the results do not apply to non-listed, banking, insurance, and financial services firms and the results are only valid for the sample period and its specific regulatory environment. Fourth, future research should also include other audit committee characteristics, if valid information is publicly available. This refers especially to the independence of members and to the duties of the audit committee, both of which are likely to influence the committee's effectiveness.

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[15] See the empirical results of Ernstberger et al. (2016) who support empirical evidence for this argumentation with regard to disclosing mandatory quarterly financial reporting.

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