MATERIALITY AND DISCLOSURE QUALITY OF IDENTIFIABLE INTANGIBLE ASSETS: EVIDENCE FROM GERMANY

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Abstract

This paper examines both the materiality of intangibles and the related disclosure quality under IFRS in the notes of firms on the German benchmark stock index DAX during the four-year period 2008-2011. As proxies, we use the relation of intangibles-to-equity (materiality) and a disclosure index of our design (disclosure quality) that measures both the volume and presentation of information. Furthermore and contrary to the majority of prior studies on the disclosure of intangibles, our index measures disclosure quality itself, and is not restricted to voluntary or mandatory disclosures. In accordance with our predictions, we find in general that intangibles are considerably material, but that the related disclosure quality is low and remains at that low level over the period analyzed. Additionally, both aspects differ widely between firms. Finally, we find support for the hypothesis that management disclosure policies place more emphasis on the amount of information than on its presentation. Our results illustrate and promote the need for the improved regulation of disclosures in the notes, as currently discussed by the major standard setters IASB and FASB.

Keywords: Disclosure Quality, Disclosure Index, Intangible Assets, IFRS

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1 Introduction

We analyze the quality of firms' communication with their investors via annual reports, which is the essence of accounting research (Buzby (1974)). For this task, annual reports are a major source of investment information (Glaum and Friedrich (2006)). Due to its importance, a considerable amount of prior accounting research has been dedicated to analyzing the quality of disclosures in order to evaluate the effectiveness of financial reporting and to identify both its determinants and effects (Healy and Palepu (2001)). However, prior research provides no consensus on what measure is most appropriate to evaluate disclosure quality, which may be attributable to the complexity of the underlying concept (Beattie, McInnes, and Fearnley (2004)). Nevertheless, this issue is critical to the evaluation and should be addressed further (Beyer et al. (2010, 311)).

In light of the above, we introduce a new measure of disclosure quality using the disclosure index methodology (Marston and Shrives (1991)). This accounting-based approach, as opposed to market-based approaches (Barth and Schipper (2008, 179-181)), evaluates disclosure quality independently from capital market data by using only annual report information and, therefore, provides a direct measurement of disclosure quality. In particular, our aim is to evaluate disclosure policies of management in order to derive implications for the improvement of existing accounting standards. For this purpose, an accounting-based approach is most suitable because it allows us to analyze information provided by annual reports more specifically (Daske and Gebhardt (2006, 462); Dye (2001, 230-231)). Beyer et al. (2010, 311) argue that quality measures of disclosure studies often lack a theoretical foundation, as the underlying disclosure quality concept has not been clearly defined. In consequence, we derive our measure

directly from a disclosure quality concept that aims at quantifying the degree to which firms' disclosures comply with investors' requirements1. We choose investors due to their prevalent role as recipients of annual report information. Furthermore, prior research using the disclosure index methodology measures disclosure quality predominantly by counting the information amount (e.g., Cooke (1989); Wang, O, and Claiborne (2008)). However, it is generally agreed upon that investors' decisions are affected by not only the amount of information, but also by its presentation (e.g., So and Smith (2004)), which is therefore important for measuring disclosure quality. We build on this concept and provide an extended evaluation of disclosure quality by measuring both volume and presentation of information, which reflects investors' requirements more precisely. Furthermore and unlike the majority of existing disclosure studies (Beyer et al. (2010)), our index measures disclosure quality itself and is not restricted to the concept of voluntary or mandatory disclosures.

Under IFRS, the notes are of considerable importance to investors (Glaum and Friedrich (2006)) due to their purpose of describing, explaining, amplifying, and objectifying items in the primary financial statements, and item-related assumptions made by management (EFRAG, ANC, and FRC (2013, 2)). Despite their importance, however, the quality of disclosures within such notes has been questioned recently (EFRAG, ANC, and FRC (2013, 6)). Therefore, the role of notes in general is currently under revision by, amongst others, the major accounting regulators FASB and IASB, with the goal of developing a disclosure framework (IASB (2013)). Our paper aims at contributing to this discussion by analyzing the quality of intangible disclosures (short for: identifiable intangible asset disclosures) in the notes under IFRS regulation. We choose intangible disclosures for the following reasons: First, intangibles are value-relevant to investors, and thereby have an important role in annual reporting (Ritter and Wells (2006); Lin and Tang (2009, 679)); Second, due to their nature, they often lack an active market (Lev (2005, 301)), which leads to the fact that their values are strongly dependent on valuation assumptions determined by management, leading in turn to potential information asymmetries (Barth, Kasznik, and McNichols (2001, 2)). Hence, there is strong demand for intangible disclosures from investors, i.e. their quality is an important factor in the overall quality of annual reporting.

Although the quality of intangible disclosures in general has been subject to extensive research in the past, this research has focused mainly on intellectual capital reporting (Guthrie, Ricceri, and Dumay (2012)). Only a few studies concentrate on intangible disclosures in the notes under IFRS (e.g., Ruhnke and Schmidt (2013)). However, the latter studies restrict their evaluation to the amount of disclosures, i.e. an extended evaluation of disclosure quality – capturing the presentation of disclosures, as conducted in this paper – is lacking.

Our paper contributes to the accounting literature in two major ways. First, we assess the quality of intangible disclosures by applying a new disclosure index, measuring both the volume and the way in which information is presented. Second, and based on our results, we reveal imperfections within IFRS disclosure regulation, and elaborate amendments that give reason to expect an improved quality of reporting.

The remainder of this paper proceeds as follows: In Section 2 we elaborate our disclosure quality concept. Section 3 develops our hypotheses. Research design and results are presented in Section 4 and Section 5, before we conclude in Section 6.

2 Disclosure quality related to intangibles

2.1 Definition and economic rationale

Despite the importance of the quality concept within accounting research, an absolute definition is lacking in the literature (e.g., Daske and Gebhardt (2006, 466–467); Collins, Pasewark, and Strawser (2002, 138); Wallace, Naser, and Mora (1994, 43)), highlighting its complexity (Beattie, McInnes, and Fearnley (2004, 230)). We define quality as the level of adequacy of information with respect to a certain objective (Singhvi and Desai (1971, 130–131); Buzby (1974, 38)), i.e. quality is characterized by *conformance to requirements* (Crosby (1979)).

Looking at economic rationales, it is generally agreed that disclosure quality is a function of several corporate and environmental characteristics, as well as managerial intentions (for an overview see, e.g., Beyer et al. (2010)). For example, firm size is assumed to have a positive effect on disclosure quality (e.g., Singhvi and Desai (1971); Ali, Ahmed, and Henry (2004); for an overview see, e.g., Oliveira, Rodrigues, and Craig (2006, 13–14)), which is due, among other factors, to scale effects, i.e. the lower relative cost of gathering information (Lang and Lundholm (1993, 251)). Furthermore, a high disclosure quality can be useful both to the management of a firm and to its investors. According to principal-agent theory (Jensen and Meckling (1976)), the management of a firm has an interest in reducing existing information asymmetries through disclosures in order to reduce the cost of capital (Verrecchia (2001)). Or put another way: A high cost of capital can be a strong incentive for management to increase disclosure quality. This relation is supported by empirical research (Botosan (1997); Lopes and Alencar (2010); Sengupta (1998)), and even applies to financial markets with a higher level of friction, such as that of Germany (Francis, Khurana, and Pereira (2005)). It has to be noted, though, that this incentive is unlikely to prompt

[1] Due to comparable demands for investment information, this also includes analysts.

management to voluntarily provide all its private information because of the existence of, among others, disclosure costs arising from disclosing unfavorable information (for a review of related literature, see e.g., Verrecchia (2001); Beyer et al. (2010)). This causes regulation, i.e. the introduction of mandatory disclosures alongside voluntary disclosures. In semi-regulated financial markets that allow for voluntary disclosure, disclosure quality is therefore the result of both the quality of management disclosure decisions and the quality of disclosure regulation.

We do not build on the commonly used mandatory vs. voluntary disclosure distinction found in the research (e.g., Beyer et al. (2010)), because our goal is to evaluate disclosure quality itself. Nevertheless, apart from results of prior research, we use existing disclosure requirements under IFRS in order to specify disclosure quality. In fact, IFRS provide a mixture of voluntary and mandatory disclosure guidelines, and are therefore an important source of requirements. We discuss both principles-based and rules-based disclosure requirements in Section 2.2 and Section 2.3, respectively.

2.2 Principles-based disclosure requirements

Starting with the principal-based requirements, the main objective of annual reports is to provide adequate information for investment decisions to investors (Singhvi and Desai (1971, 130–131); Barth, Landsman, and Lang (2008, 471)). This concept is present in the Framework (short for: IFRS Framework) under the term decision usefulness (Framework QC1). Accordingly, information is useful if it is both relevant, i.e. it is capable of influencing investment decisions by providing a predictive and/or confirmatory value (Framework QC6-QC10), and if it is faithfully represented, i.e. it is complete, neutral, and free from error (Framework QC12-QC15). Relevance is thereby directly dependent on the nature and magnitude of items within the entity-specific context, i.e. their materiality (Framework QC11). However, these requirements are opposed in most cases. For example, if the value of an asset is based on the fair value approximated by using discounted cash flow projections, this information will be considered more relevant than historical costs by most investors. In contrast, however, this information is only known to, or better known by, management, which therefore has an inherent information advantage. Furthermore, present IFRS leave the determination of the materiality threshold at management discretion. An opportunistic management, therefore, has the possibility to practice earnings management, i.e. to misrepresent the true economic performance (McVay (2006, 501)). Rational investors will appreciate this and will only use information that is both relevant and faithfully represented, at least if they cannot separately identify information that is represented in a highly unfaithful manner (Barth, Clinch, and Shibano (2003, 604)). Therefore, a maximum level of decision usefulness is the result of pondering relevance and faithful representation together, and not by maximizing them singularly (Framework QC17).

Even though prior research indicates value relevance both of accounting amounts in general (e.g., Barth, Landsman, and Lang (2008); Bartov, Goldberg, and Kim (2005)) and intangibles in particular (e.g., Ritter and Wells (2006); Goodwin and Ahmed (2006)), there are no studies that analyze value relevance for intangible disclosures in the notes. Presumably, this is because of the predominantly different kind of information that is presented in the notes and the associated measurement difficulties. But since intangibles are relevant, there is strong reason to assume that complementing disclosures like e.g., useful life, which are especially helpful to predict both future depreciations and related earnings effects, are also relevant to investors (similarly to e.g., Schmalenbach-Gesellschaft (2005, 82)). The nature of items is one reason for qualifying information as relevant, while another reason might be the magnitude.

Furthermore, the requirement of faithfully representing disclosures is especially important with respect to intangibles. The value determination depends to a higher degree on discounted cash flow projections due to the rarity of active markets (Lev (2005, 301)). Hence, recognized values of intangibles are more subject to bias under present IFRS than is the case for other assets, e.g. PPE. Requiring a complete depiction of underlying assumptions – e.g. discount rates or applied valuation techniques – is therefore especially helpful in this context to investors trying to identify biased information and verify the amounts given (Framework QC16; Framework QC26). This restricts possibilities for earnings management.

However, there are some limits to this conclusion that follow from information processing by investors. The reasons for this are that the decision quality depends both on the professionalism of users (e.g., Vera-Muñoz, Kinney Jr., and Bonner (2001)) and on the information complexity, which is, amongst other factors[2], dependent on the type of information itself (Plumlee (2003); Tarca et al. (2008)) as well as on the amount of information and its presentation (e.g., Hard and Vanecek (1991)). Complexity due to the type of information predominantly arises from measurement rules under IFRS, which are outside the scope of this paper. However, assuming that related disclosures require a high amount of information, this may lead to the phenomenon of limited user attention, as users face time, effort, and cognitive resource constraints (e.g., Hirshleifer and Teoh (2003); Hirshleifer, Seongyeon, and Teoh (2009); Bloomfield (2002)), a situation that remains true even for professional users

[2] There are other factors, e.g. readability (e.g., Miller (2010)) and tone (e.g., Li (2010)) of information. We do not discuss these results here for reasons of focusing.

(e.g., Hirst, Hopkins, and Wahlen (2004)). Therefore, conciseness is required (Framework QC30), which may, however, impair a complete depiction as described earlier. Hence, the determination of the right amount of information is the result of a case-specific trade-off against completeness. We follow the hierarchy stated under IFRS, whereby a complete depiction of material items is more important to the investors than minimizing the amount of information (Framework QC19; Framework QC31).

Furthermore, the method of presentation may affect decision quality. If information is presented more prominently in a primary financial statement, this will improve the acquisition (Hirst and Hopkins (1998)) and weighting of that information by investors (Maines and McDaniel (2000)), i.e. the location of information within annual reports matters. The importance of disclosures within notes, i.e. a non-primary financial statement, may therefore be downgraded due to their processing from investors, and not due to their potential relevance (e.g., Hirst, Hopkins, and Wahlen (2004, 459)). A solution to this problem could be to require more information in primary statements, e.g. the balance sheet. With respect to conciseness, however, this surely would not lead to increased decision usefulness. The trade-off proposed in this paper is to require additional information – such as useful lives or disaggregated carrying amounts of intangibles – to be a) presented in the notes, facilitating concise primary statements, and b) to be formatted in a way that enhances information processing. Among other methods, the latter may be done by emphasizing and structuring information reasonably.

It is generally agreed upon that emphasizing by using graphs or tables can affect decision quality depending on the task performed (see Kelton, Pennington, and Tuttle (2010, 83–84) for a review). Though results are mixed, this may be due to differing task definitions (Kelton, Pennington, and Tuttle (2010, 84)) and user professionalism (Dilla, Janvrin, and Jeffrey (2013)). We follow the method of Hard and Vanecek (1991, 39), who differentiate between four types with increasing complexity, i.e. accumulation, recognition, estimation, and projection tasks. Taking the relevance concept stated before into account, we consider projection tasks as being most applicable to investors analyzing disclosures contained in notes. For these complex tasks, the tabular format increases the decision quality of both professional and non-professional investors compared to the graphical format (Hard and Vanecek (1991)). Without differing with respect to professionalism and using another task-complexity proxy, So and Smith (2004) provide similar results. Furthermore, emphasizing by using bold print or different colors may also support a higher decision quality by reducing search time (Wu and Yuan (2003); Fisher et al. (1989)). Therefore, it is merely consistent to assume that table-based depictions or, at least, highlighted texts are preferable with respect to disclosures in the notes. Furthermore, meaningful categorization approaches may further enhance the decision quality of investors (Buzby (1974, 45)). Bearing this in mind, investors require information to be understandable and, thus, to be possessed of both conciseness and clarity, i.e. the right amount of information married with the appropriate presentation of information (Framework QC30). Therefore, it is not only important what items of information are disclosed, but also how the disclosure is done.

Finally, investment decisions require comparability of disclosures across firms and over time (Framework QC20; Botosan (2004, 291)).

2.3 Rules-based disclosure requirements

Rules-based disclosure requirements under IFRS as detailed in Appendix A do not sufficiently reflect the previously-stated principles. These 'case-by-case' requirements, resulting from an ad hoc and pragmatic standard-setting approach (Schipper (2007, 308–309)), lack a clear regulatory concept – a factor which most probably impairs decision usefulness. To ensure this usefulness, we require firms to enhance their disclosures with respect to the following aspects.

First, IFRS require fewer disclosures for intangibles with finite useful lives with respect to the measurement of recoverable amounts. There is no reason to assume that amortizations reduce the information needs of investors regarding the underlying valuation assumptions of recoverable amounts. In order to ensure a relevant and complete depiction, we require the same disclosures for intangibles with finite and indefinite useful lives with respect to measurement of recoverable amounts.

Second, IFRS require firms to disclose the respective valuation technique applied, e.g. the income approach. This information is too aggregated to be useful for decision making. Instead, we require firms to disclose the specific valuation method, e.g. the "Relief from Royalty" method, which is often practiced for intangibles (e.g., Parr and Smith (2005, 194)). This provides further insights into the valuation techniques applied, and enhances the relevance and completeness of information.

Third, IFRS do not require firms to apply a specific method of presentation. Due to the fact that text-based disclosures are of lower quality, we require firms to use table-based or otherwise-highlighted disclosures in order to enhance understandability and comparability.

Fourth, in accordance with the principles stated above, disclosure requirements under IFRS depend on the interpretation of materiality and relevance, respectively. This is especially important in the case of the disaggregation level (e.g. IAS 38.119) and in impairment-related disclosures (e.g., IAS 36.130). However, a general operational metric is lacking. This provides management an opportunity to practice

earnings management by, for instance, choosing not to disclose unfavorable information. Such behavior impairs the relevance, completeness, and comparability of disclosures. Therefore, disclosures need to be adjusted by a standardized metric of materiality introduced in Section 4.2.

Finally, IFRS provide a meaningful guideline for structuring and categorizing intangible disclosures on the basis of major classes (IFRS IE16) and classes (IAS 38.119). However, it is not specified whether firms have to provide disclosures related to both major classes and classes or if only one of these approaches is sufficient. In order to ensure relevance, comparability, and understandability, we require firms to disclose intangible information on the major class and class level.

3 Hypothesis development

Many studies analyze intangible disclosures in annual reports, e.g. focusing on intellectual capital reporting (for an overview see e.g., Guthrie, Ricceri, and Dumay (2012)), but only a few analyze intangibles in terms similar to those in this paper. Appendix B summarizes population, design, and results of such studies. However, these studies are subject to three possible limitations regarding hypothesis development, which must be addressed beforehand.

First, only one of the studies (Hager and Hitz (2007)) differentiates between disclosures regarding identifiable intangible assets and goodwill. Even though the majority do not focus on identifiable intangible assets, they allow for recognition of tendencies regarding disclosure practice, and are therefore included. Second, these studies mainly focus on mandatory disclosures. However, the concept of mandatory and voluntary disclosures is often not well specified (Heitzman, Wasley, and Zimmerman (2010, 110))[3]. Within IFRS and especially within the intangible disclosure requirements, the difference between these two characteristics is predominantly made by the interpretation of materiality. For example, if management interprets an impairment loss on intangibles as non-material, they are not obliged to provide disclosures under IAS 36.130. Because this categorization is inherently endogenous, researchers can only resolve this issue either by selecting only requirements that are unambiguously mandatory or by making assumptions regarding the interpretation of materiality, as done by Hager and Hitz (2007) and ESMA (2013), respectively. Due to the fact that materiality and mandatory requirements are key components of disclosure quality, as explained in Section 2, these studies presumably give a stronger indication towards disclosure quality than the other studies. Third, the results presumably lack generality. No statistical tests are applied within the selected studies, so that the results only can be interpreted as individual case observations. As a result of this, and in order to get sound results, we will only state undirected hypotheses.

All selected studies indicate a considerable relation of intangibles to assets and equity, respectively. Furthermore, Frey and Oehler (2009) and Frey (2010) indicate a steady increase. This leads to our first hypothesis:

H1. *The materiality of intangibles changes over time.*

All studies could identify non-compliance over the analyzed period. Hager and Hitz (2007) and ESMA (2013) show the same results despite adjustments for mandatory disclosures and materiality. Why management may not comply with mandatory disclosures is rarely analyzed in prior research (Dye (2001)). Prior research indicates that the cost of capital-based incentives work, even though the financial system has frictions like those of the German system (Francis, Khurana, and Pereira (2005)). Although this result is based on voluntary disclosures, there is no reason why this would not apply to mandatory disclosures and disclosure quality. However, this review of specific prior research indicates that the issue of non-compliance is relevant with respect to intangible disclosures, and needs to be analyzed in general. Assuming that non-compliance is a good proxy for unsatisfactory disclosure quality, we derive our second hypothesis:

H2. *Intangible disclosure quality is unsatisfactory.*

Comparing the disclosures across firms, Kirsch, Koelen, and Tinz (2008), Frey and Oehler (2009), and Frey (2010) conclude that the disclosed content is heterogeneous. Hence, and due to the fact that intangible disclosures are subject to an inherently arbitrary interpretation of materiality by management, we would expect that the disclosure comparability across firms is low at a given point in time (Botosan (2004, 291)). Therefore, the third hypothesis is as follows:

H3. *Intangible disclosure quality differs widely between firms.*

When looking at the longitudinal studies, Frey and Oehler (2009), Frey (2010) and Ruhnke and Schmidt (2013) identify an increasing disclosure content. This is somewhat surprising, given that other studies (e.g., Lang and Lundholm (1993, 267); Francis, Nanda, and Olsson (2008, 63)) did not identify a change. Presumably, the reason for the different results is that the latter studies analyze a) voluntary disclosures, and b) expand their analysis to the complete annual report, i.e. they do not focus on intangible disclosures. Hence, we follow the specific studies and would expect low intertemporal disclosure comparability. This leads to the fourth hypothesis:

[3] Although Heitzman, Wasley, and Zimmerman (2010, 110) argue that materiality thresholds have to be addressed in voluntary disclosure research, this conclusion is also relevant for the opposite perspective, i.e. measuring mandatory disclosures.

H4. *Intangible disclosure quality changes over time.*

Hager and Hitz (2007, 211–212) conduct the only study that considers clarity in some sense, by stating that standardization regarding the method of representation is lacking. Additionally, it may be assumed that a large proportion of the notes are based on text, rather than on more comprehensible forms like tables. The content and structure of such disclosures may thus be expected to be of a higher quality than that of their presentation. In order to obtain sound results, our fifth hypothesis is also undirected:

H5. *The content and structure dimension of intangible disclosure quality differs from the respective presentation dimension.*

4 Research design

4.1 Sample selection

The sample is selected with respect to the following aspects. First, considering the size effect on disclosure policies as depicted in Section 2.1 and in order to derive implications for an improvement of existing regulation, it is interesting to observe how the largest firms make financial disclosures to investors. If even these firms show deficiencies in reporting, this provides us with a strong reason to believe that the regulation needs to be revised. Second, the time-consuming direct analysis of disclosures makes it necessary to adjust the focus. Therefore, we apply our analysis to firms within the German DAX[4] spanning the years 2008-2011. Finally, in order to eliminate effects of altering cross-sectional variation over time due to varying composition, we select firms based on the DAX composition from 12-31-2011.

4.2 Measurement of disclosure quality

Following the review of existing intangible disclosure literature in Section 3, no specific measures for disclosure quality are found to exist. However, when examining disclosure research in general, disclosure quality is measured according to several approaches which can be categorized in various ways. We differentiate between market-based and accounting-based approaches (similarly to Barth and Schipper (2008, 179–181)). Market-based approaches evaluate disclosure quality from relations between selected annual report information, e.g. earnings, and capital market data, e.g. stock returns (see e.g., Barth, Konchitchki, and Landsman (2013); Bartov, Goldberg, and Kim (2005)), and therefore provide an indirect measurement of disclosure quality. Accounting-based approaches evaluate disclosure quality without reference to capital markets by using only annual report information, and therefore provide a direct measurement of disclosure quality. In general, this approach allows for a more specific analysis of the information content provided by annual reports (Daske and Gebhardt (2006, 462)) and therefore is more useful in deriving implications regarding accounting standards (Dye (2001, 230–231)). Considering this, we decide that an accounting-based approach is most appropriate for our analysis of intangible disclosures. Research offers a variety of accounting-based measures, e.g. accruals quality (e.g., Francis et al. (2005)) or earnings quality (Francis, Nanda, and Olsson (2008); for a thorough review see Dechow, Ge, and Schrand (2010)), natural language processing measures like readability (e.g., Miller (2010)) or tone (e.g., Li (2010)) of disclosures, and disclosure index measures (for an overview of the earlier studies see Marston and Shrives (1991)). We base our analysis on the disclosure index methodology, which is presented and discussed in the following.

The rationale of a disclosure index is to evaluate the level of conformance by comparing information presented to a normative catalogue of requirements. Accordingly, a high disclosure score indicates a high level of conformance (with a low disclosure score indicating a correspondingly low conformance level). The majority of studies use the authors' own disclosure indices that derive their requirements from several sources, such as accounting standards (e.g., Wallace, Naser, and Mora (1994)) or professional announcements (e.g., Lapointe-Antunes et al. (2006)). The general advantage of such indices is their adaptability to different research questions, especially for micro-level analyses (e.g., Beattie, McInnes, and Fearnley (2004, 233)). On the other hand, they are also time-consuming and, hence, lack feasibility for larger samples, which may impair generality (e.g., Core (2001, 452). Additionally, they often require judgments of the researcher, which may impair the reliability of their results (Marston and Shrives (1991, 197)), i.e. they are difficult to replicate (Healy and Palepu (2001, 427)). Some studies use professional ratings for indices in order to analyze larger samples (e.g., Daske and Gebhardt (2006, 462)). However, these external rating-based measures are inherently less transparent and, therefore, may provide less valid results (Healy and Palepu (2001, 426–427)). We use our own index because we consider this to be the appropriate research instrument to analyze our micro-level-oriented research question.

Index validity strongly depends on both the definition of requirements and the method of measurement. Prior studies often base their requirements on relevance and completeness of information, i.e. focusing on the amount of information (e.g., Cooke (1989); Gray, Meek, and Roberts (1995); Wang, O, and Claiborne (2008)). Closely related to this is the use of a dichotomous

[4] "The DAX reflects the segment of blue chips (...) and comprises the 30 largest and most actively traded companies that are listed at the (...) Frankfurt Stock Exchange" (Deutsche Börse (2013, 8)).

scoring procedure, wherein a firm scores 1 if the respective item of information is disclosed, or 0 if it is not. Considering the discussion of requirements in Section 2.2, such index construction may lead to an incomplete and, therefore, less valid measure of quality (Beretta and Bozzolan (2004, 269–270)). Therefore, other disclosure studies follow a non-dichotomous procedure in order to better reflect the underlying information characteristics. For example, Botosan (1997) constructs a disclosure index that attributes higher values if firms disclose quantitative instead of qualitative information, arguing that the former represents more precise and therefore more useful information. Taking into account that there is no agreed theory in the literature on the selection of items to be included in the index (Wallace, Naser, and Mora (1994, 43)) and that amount-only approaches are incomplete, we derive our items from the disclosure requirements elaborated in Section 2 following a non-dichotomous procedure in order to ensure the validity of our results. However, due to the fact that intangible disclosures are predominantly quantitative, we do not build on the quantitative-qualitative distinction, but rather score disclosures additionally if they exhibit higher clarity.

Considering that only material information enhances decision usefulness, our index was therefore adjusted for materiality. According to IFRS and as depicted in Section 2.2, materiality depends on the nature and magnitude of items. There are some indications on how to measure materiality by magnitude. For example, IAS 36.134 proposes the relation of the individual intangible carrying amount to the sum of intangible carrying amounts. However, a general operational metric is lacking. Nevertheless, prior research has developed several approaches in order to solve this issue. Regarding materiality by nature, the maximum score achievable is usually adjusted for items that are not considered to be material based on comprehensive examination of annual reports (e.g., Ali, Ahmed, and Henry (2004); Hossain, Perera, and Rahman (1995)). Other studies quantify materiality by using accounting-based measures, e.g. financial statement relations, or market-based measures, e.g. earnings response coefficients (Heitzman, Wasley, and Zimmerman (2010, 118)). Analogously to our reasoning of selecting the disclosure index methodology, we choose an accounting-based measure of materiality because it is most appropriate to our research question. Though this approach is also somewhat arbitrary, it is more transparent than nature-based materiality measures, and is therefore preferable. Accordingly, we only analyze disclosures of firms with an intangible-to-equity ratio (similarly to e.g., ESMA (2013, 6)) of at least 10 %. Due to the fact that the German DAX firms do not apply the revaluation model for intangibles, we exclude related disclosures from our analysis.

Assuming that different users of financial statements may attach varying degrees of importance to their requirements, some studies use weighted indices with weights derived from financial statement user surveys (e.g., Singhvi and Desai (1971), Firth (1979)). Though this may be justifiable from a theoretical point of view, we follow the majority of studies in using unweighted indices for the following reasons. On the one hand, surveys themselves are subject to validity issues and may, therefore, further bias the index calculation (Chow and Wong-Boren (1987, 536). On the other hand, there is evidence that unweighted indices provide comparable results (e.g., Firth (1980); Chow and Wong-Boren (1987)), i.e. the higher complexity of weighted approaches is not appropriate. Finally, our quality measure is not restricted to a subgroup of users such as analysts, which means that there is good reason to believe that group-specific preferences will average each other out (Cooke (1989, 182)).

The index is compiled based on hand-collected data. The data are extracted from the balance sheet (materiality) and the notes (disclosure index) to financial statements. We differentiate between two information dimensions of disclosures: content and categorization (the CC score) as well as formatting (the FT score). A detailed description of the index construction is provided in AppendixC.

5 Results

5.1 Materiality

Table 1 presents the descriptive statistics for materiality, measured as the intangibles-to-equity ratio. The adjustment for materiality led to the exclusion from the index analysis of ten firms that exhibited an intangible-to-equity ratio of less than ten percent in more than two of the four financial years. It must be noted that from 2008 to 2011, intangibles account for 16.8 % (median) and 21.8 % (mean) of equity, respectively. In accordance with prior research, this illustrates that intangibles play a substantial role in the accounting systems of German DAX firms. Furthermore, the large range and standard deviation indicate large cross-sectional differences. Looking at the development between each 2 sample year, an increase in materiality from 2008 to 2009 is followed by a decrease from 2009 to 2011. The change between 2008 and 2011 from 15.8 % to 14.9 % (median) indicates a minor decrease in materiality. The mean values yield analogous results. The following tests focus on the analysis of median differences, with results presented in Table 2.

Table 1. Descriptive statistics for materiality

Statistic	2008-2011	2008	2009	2010	2011
Mean	21.76	22.77	23.12	21.18	19.97
Median	16.75	15.76	18.73	17.39	14.87
Standard deviation	19.47	21.91	18.39	19.03	18.49
Minimum	0.62	0.62	2.41	2.51	2.55
Maximum	85.38	85.38	74.81	77.36	82.47
Observations	120	30	30	30	30

This table presents the descriptive statistics of materiality, i.e. the intangible-to-equity ratio. All statistics – except for the number of observations – are presented in %.

Since this study uses a repeated measures design, the Friedman two-way analysis of variance by ranks and the Wilcoxon matched-pairs signed-ranks test are applied. We use non-parametric tests due to the fact that our materiality proxy lacks normality – as discussed in Appendix D.

The hypothesis of an overall difference of median values between 2008 and 2011 is accepted on a 5 % significance level. More specifically, the pairwise comparisons show that this result can be attributed to differences between 2009 and 2010, and between 2009 and 2011 on a 1 % significance level, as well as between 2010 and 2011 on a 10 % significance level. Thus, no statistical evidence is found of a significant change in median between 2008 and 2011. Predominantly, these results correspond with the prior interpretation of the descriptive statistics. However, despite the relatively large median difference between 2008 and 2009, the difference is not significant.

As a general statement, we can say the following: Intangibles owned by German DAX firms are reasonably material both on a mean and a median basis if compared with equity values. However, cross-sectional differences are high, and significant changes occur between several pairs of years. Nevertheless, the change from 2008 to 2011 is not significant, i.e. the materiality remains on a constant level, and *H1* is, therefore, only supported in part.

Table 2. Analysis of median differences over time for materiality

Friedman	Wilcoxon			
2008-2011	Comparison year	2008	2009	2010
7.8400 (0.0494)**	2009	217 (0.7499)	-	-
	2010	195 (0.4405)	**89*** (0.0032)**	-
	2011	160 (0.1359)	**93*** (0.0041)**	**140* (0.0571)**

This table presents the statistics of the Friedman Two-Way Analysis of Variance by Ranks (Friedman) and the Wilcoxon Matched-Pairs Signed-Ranks test (Wilcoxon), with the corresponding p-values given in parentheses. The test statistics test the hypothesis that the medians of materiality of the respective years are equal to each other. * / ** / *** indicate significance at the 10 % / 5 % / 1 % level.

5.2 Disclosure index

Table 3 presents the descriptive statistics for the disclosure index. In the case of firms without intangibles that have indefinite useful lives, the maximum score would have been adjusted. This is not the case for the underlying sample. Therefore, we present both absolute and relative values, whereby the relative values are divided by the maximum achievable scores. We apply both parametric and non-parametric tests to our disclosure index, as discussed in Appendix D. Looking first at the minimum and maximum values of the DQ score, the large range is noticeable for both the overall period and for each year. In combination with considerable standard deviations, this indicates large cross-sectional differences. The comparability of disclosures across firms at a given point is therefore low, and supports *H3*. Furthermore, a comparison of the range with the respective mean and median values leads to the conclusion that the average disclosure quality is low, but that there are at least individual firms that provide a considerably higher disclosure quality. CC and FT scores provide analogous results. One example for this is Deutsche Börse AG, which features the highest scores in every year examined. Testing *H2*, a low

disclosure quality is corroborated according to both parametric and non-parametric tests, with the results presented in *Table 4*. The DQ, CC, and FT scores are significantly lower (p-value < 0.01) than the respective maximum achievable scores. In fact, firms tend to disperse their information into two to three locations in the notes (similar to Hager and Hitz (2007, 210)), which makes the disclosures less comprehensive and the processing of information very time consuming. This in general leads to less understandable and comparable disclosures and therefore, at least in part, to a low level of disclosure quality.

Noteworthy is the fact that except for the range in 2008, the considered metrics (i.e. range, mean and median) of the CC score are noticeably higher than those of the FT score. Testing *H5*, the t-Test identifies significant differences in mean and median values between both scores in each year (p-value < 0.05 in 2008 and 2010; p-value < 0.01 in 2009 and 2011) with the results presented in Table 5. It has to be recognized that the t-Test is sensitive to the assumption of equal variance in both groups, which was therefore tested beforehand. According to this, the hypothesis of equal variances was rejected in 2009 (p-value < 0.05), 2010 (p-value < 0.1), and 2011 (p-value < 0.01). However, due to the fact that the Wilcoxon Test supports *H5* (p-value < 0.05), there is no reason why unequal variances might impair the validity of our results.

Table 3. Descriptive statistics for disclosure index

Score	Parameter	2008-2011	2008	2009	2010	2011
DQ	Mean	10.78 23.43 %	10.35 22.50 %	10.30 22.39 %	11.15 24.24 %	11.30 24.57%
	Median	12.0 26.09 %	11.5 25.00 %	11.5 25.00 %	12.0 26.09 %	11.5 25.00 %
	Standard deviation	6.18	6.23	6.09	5.82	6.96
	Minimum	0 0 %	0 0 %	0 0 %	2 4.35 %	2 4.35 %
	Maximum	30 65.22 %	22 43.48 %	27 58.70 %	26 56.52 %	30 65.22 %
	Observations	80	20	20	20	20
CC	Mean	6.30 27.39 %	5.85 25.43 %	5.95 25.87 %	6.60 28.70 %	6.80 29.57 %
	Median	6.0 26.09 %	5.5 23.91 %	5.5 23.91 %	6.0 26.09 %	5.5 23.91 %
	Standard deviation	3.99	3.51	3.79	3.87	4.87
	Minimum	0 0 %	0 0 %	0 0 %	1 4.35 %	1 4.35 %
	Maximum	19 82.61 %	11 47.83 %	16 69.57 %	15 65.22 %	19 82.61 %
	Observations	80	20	20	20	20
FT	Mean	4.48 19.48 %	4.50 19.57 %	4.35 18.91 %	4.55 19.78 %	4.50 19.57 %
	Median	4.0 17.39 %	4.0 17.39 %	4.0 17.39 %	4.0 17.39 %	4.0 17.39 %
	Standard deviation	2.70	3.09	2.62	2.68	2.61
	Minimum	0 0 %	0 0 %	0 0 %	1 4.35 %	1 4.35 %
	Maximum	11 47.83 %	11 47.83 %	11 47.83 %	11 47.83 %	11 47.83 %
	Observations	80	20	20	20	20

This table presents the descriptive statistics of the DQ / CC / FT scores of German DAX firms with an intangibles-to-equity ratio of at least 10 % in at least two financial years during the time period 2008-2011. Percentage values are related to the respective maximum achievable DQ (46) / CC (23) / FT (23) score.

Table 4. Analysis of disclosure index level

Score	Test	2008	2009	2010	2011
DQ	t-Test	**-25.5718*** (0.0000)**	**-26.2248*** (0.000)**	**-26.8004*** (0.0000)**	**-22.2987*** (0.0000)**
	Wilcoxon	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**
CC	t-Test	**-21.8292*** (0.0000)**	**-20.1175*** (0.0000)**	**-18.9437*** (0.0000)**	**-14.8670*** (0.0000)**
	Wilcoxon	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**
FT	t-Test	**-26.8055*** (0.0000)**	**-31.8187*** (0.0000)**	**-30.7332*** (0.0000)**	**-31.7518*** (0.0000)**
	Wilcoxon	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**	**0*** (0.0001)**

This table presents the statistics of the Single-Sample t-Test (t-Test) and the Wilcoxon Signed-Ranks Test (Wilcoxon), with the corresponding p-values given in parentheses. The test statistics test the hypothesis that the mean / median scores of the respective years equal the maximum achievable score against the alternative hypothesis that the mean / median scores of the respective years are less than the maximum achievable score (one-tailed test). * / ** / *** indicate significance at the 10 % / 5 % / 1 % level.

Table 5. Analysis of mean and median differences between CC and FT score

Test	2008	2009	2010	2011
t-Test	**2.7355** (0.0131)**	**3.0762*** (0.0062)**	**2.8190** (0.0110)**	**2.8929*** (0.0093)**
Wilcoxon	**23** (0.0190)**	**21** (0.0104)**	**21** (0.0104)**	**21** (0.0104)**

This table presents the statistics of the t-Test for Two Dependent Samples (t-Test) and the Wilcoxon Matched-Pairs Signed-Ranks Test (Wilcoxon), with the corresponding p-values given in parentheses. The test statistics test the hypothesis that the mean scores of the CC score and the FT score are equal to each other in the respective years. The t-Test is sensitive to violations of the homogeneity of variance assumption. Therefore, we apply the t-Test for homogeneity of variance for two dependent samples incorporating correlations between subject's scores (Sheskin (2011, 772)), which shows a rejection of the equal variance hypothesis in three years. However, due to the fact that the Wilcoxon test supports the t-Test results, we see no reason why unequal variances might impair the validity of our results. * / ** / *** indicate significance at the 10 % / 5 % / 1 % level.

Considering the longitudinal development from 2008 to 2011, the following developments can be recognized. The range of the DQ score expanded from 43 % to 61 %, attributable to a strong increase of the CC score from 48 % to 78 %, and a weak decrease of the FT score from 48 % to 43 %, respectively. The mean values of the DQ and CC scores also increase, albeit in a less pronounced manner. However, with the exception of the DQ score in 2009, the development is steady. The development of the FT score is indecisive. In contrast, the median values of all three scores remain unchanged when comparing the values of 2008 and 2011.

In order to test *H4*, i.e. significant changes of disclosure index scores from 2008 to 2011, we apply several statistical tests. Table 6 and Table 7 present the results for mean and median differences, respectively, differentiated into the three scores. Looking first at the results of the analysis of overall mean differences (ANOVA), no statistical evidence of a significant development of the disclosure scores during the sample period can be found. This is supported by the non-parametric analysis of overall median differences (Friedman). However, the detailed analysis of single pairwise comparisons reveals that, at least between 2009 and 2011, significant mean differences of the DQ and CC score exist (p-value < 0.1). The differences between 2009 and 2011 are corroborated by the non-parametric analysis of median differences on a higher significance level (p-value < 0.05). However, the non-parametric test shows a significant change of the CC score from 2008 to 2010

(p-value < 0.1). This may be due to non-normality. Considering the above points, we conclude that there is at least some significant development of the disclosure index between years, especially the positive development of the DQ and CC score from 2009 to 2011, as indicated by both tests. In comparison, however, we find no support for the suggestion that the FT score changes. These results suggest that differences between years, however, only occur in part but not generally, i.e. the disclosures do not improve in quality.

Table 6. Analysis of mean differences over time for disclosure index

Score	ANOVA	Multiple t-Tests			
	2008-2011	Comparison year	2008	2009	2010
DQ	0.9645 (0.4158)	2009	0.0055 (0.9417)	-	-
		2010	0.8128 (0.3786)	1.6485 (0.2146)	-
		2011	1.2473 (0.2780)	**3.7255*** **(0.0687)**	0.0305 (0.8633)
CC	1.8972 (0.1403)	2009	0.0615 (0.8068)	-	-
		2010	2.1429 (0.1596)	2.7421 (0.1142)	-
		2011	2.2422 (0.1507)	**3.7843*** **(0.0667)**	0.1743 (0.6810)
FT	0.1256 (0.9446)	2009	0.2339 (0.6342)	-	-
		2010	0.0120 (0.9138)	0.3089 (0.5848)	-
		2011	0.0000 (1.0000)	1.0000 (0.3299)	0.0156 (0.9020)

This table presents the statistics of the Single-Factor Within-Subjects Analysis of Variance (ANOVA) and the Multiple t-Tests / Fisher's LSD-Test (Multiple t-Tests), with the corresponding p-values given in parentheses. The test statistics test the hypothesis that the mean scores of the respective years are equal to each other. For ANOVA, the Huyn-Feldt Epsilon is larger than 0.75. However, a value of more than 0.90 is generally required to ensure that the sphericity assumption is not violated (Sheskin (2011, 1066)). Therefore, we calculate both adjusted (according to Huyn-Feldt, Greenhouse and Geisser, and Box, respectively) and regular statistics. The results are comparable, which is why we only present the latter. Furthermore, the non-parametric Friedman-Test depicted in Table 7 supports these results. The Multiple t-Tests use MS_{res} of ANOVA, and are therefore also sensitive to violations of the sphericity assumption. Because of this, we additionally use an alternative methodology for computing MS_{res}, applying ANOVA based only on the data for each pair of years involved (Sheskin (2011, 1055)). This test is sensitive to violations of the homogeneity of variance assumption. The t-Test for homogeneity of variance for two dependent samples incorporating correlations between subject's scores (Sheskin (2011, 772)) shows a rejection of the equal variance hypothesis in four paired comparison years, i.e. in 2009/2011 for the DQ score (p-value < 0.1), and in 2008/2011 (p-value < 0.05), 2009/2011 (p-value < 0.01), and 2010/2011 (p-value < 0.05) for the CC score. Despite this, the results are supported further by the non-parametric Wilcoxon Test as depicted in Table 7. Therefore, we only present the results of Multiple t-Tests using the alternative MSres. * / ** / *** indicate significance at the 10 % / 5 % / 1 % level.

Table 7. Analysis of median differences over time for disclosure index

Score	Friedman	Wilcoxon			
	2008-2011	Comparison year	2008	2009	2010
DQ	1.2750 (0.7351)	2009	37 (0.6917)	-	-
		2010	33 (0.2413)	33 (0.5521)	-
		2011	20 (0.1310)	**0** ** **(0.0459)**	20 (0.6058)
CC	1.9950 (0.5734)	2009	36.5 (0.6735)	-	-
		2010	**18.5*** **(0.0701)**	16.5 (0.1579**)**	-
		2011	17.5 (0.1040)	**0** ** **(0.0459)**	19.5 (0.5847)
FT	0.0450 (0.9975)	2009	36 (0.9596)	-	-
		2010	52 (0.9815)	36 (0.9570)	-
		2011	36 (0.6555)	18 (0.5237)	19 (0.9711)

This table presents the statistics of the Friedman Two-Way Analysis of Variance by Ranks (Friedman) and the Wilcoxon Matched-Pairs Signed-Ranks Test (Wilcoxon), with the corresponding p-values given in parentheses. The test statistics test the hypothesis that the median scores of the respective years are equal to each other. * / ** / *** indicate significance at the 10 % / 5 % / 1 % level.

6 Conclusion

Our analysis of German DAX firms shows that the overall materiality of intangibles, as measured by the intangible-to-equity ratio, remains on a constant high level over the period spanning 2008-2011. Nevertheless, changes occur over time. Furthermore, we notice large cross-sectional differences. Despite the fact that intangibles are generally material, the results show that the intangible reporting quality, as measured by a disclosure index of our design, is low. Contrary to the majority of prior studies, our index measures disclosure quality itself and is not focused on voluntary or mandatory disclosures. Individual firms, nonetheless, achieve considerably higher scores than the mean or median of the population. Therefore, intangible disclosure quality differs widely between firms. Differences between years, however, can only be identified in part but not generally, i.e. intangible disclosure quality remains on a low level. Finally, it is of note that firms' disclosure policies emphasize the amount of information more than the method of presentation.

Since the reporting quality is too low with respect to the materiality at hand, we encourage both the standard setter (IASB) to develop more straightforward accounting rules, and the firms to develop better disclosure policies. Present accounting rules are, in fact, mostly the result of an ad hoc and pragmatic standard-setting approach (Schipper (2007, 308–309)) that lack a clear regulatory concept. Furthermore, as has been proven in this paper, they provide the management with extensive degrees of freedom that lead to an insufficient quality of reporting. Hence, our construction of the disclosure index provides an appropriate guideline to improve existing intangible disclosure rules as demanded in prior disclosure research (e.g., Oliveira, Rodrigues, and Craig (2006, 28)).

Another issue is that of management's disclosure decisions. Though our analysis focuses on quality, we notice a considerable degree of non-compliance. For example, some firms that capitalize internally-generated intangibles do not disclose them separately in the notes, even though they are obliged to do so according to IAS 38.118. This indicates weak enforcement institutions in the German capital market. Additionally, it is noteworthy that firms obviously do not choose a high disclosure quality voluntarily. Both the latter fact and the prevalence of non-compliance indicate that management obviously does not attempt to reduce existing information asymmetries. Though

this behavior can be attributed to several reasons in theory, e.g. earnings management and weak disciplining forces of investors due to friction in capital markets, empirical evidence provides no holistic answers to these issues (for a review of related literature, see e.g. Beyer et al. (2010)). Although this may in part be due to inherent measurement problems, it is also an avenue for future research.

Furthermore, disclosure policies are contingent on several corporate and environmental characteristics. In this context, our results are especially interesting in view of the fact that we analyze the most important capital market-oriented German firms. A promising question for future research is whether firms in other German indices, e.g. the MDAX or SDAX, or in comparable indices of other countries, apply different intangible disclosure policies. Furthermore, our results indicate that intangible disclosure policies differ across firms. This may be due to different industry characteristics. For example, the analysis of intellectual capital statements by Bellora and Guenther (2013) indicates that firms in research-intensive industries may emphasize intangibles and related disclosure policies more when compared with firms in less research-intensive industries. Future research may provide further insights into this relation by analyzing intangible disclosures in annual reports.

Our study is subject to several limitations. First, we analyze a small sample with a focus on German DAX firms, which may lead to lower generality of our results. Nevertheless, in our opinion the potential for gaining new insights into disclosure quality outweighs the disadvantage of achieving lower generality. Further research should expand our analysis across different countries and indices. Second, the disclosure index methodology is subject to individual perceptions of and assumptions made by the individual coders. Although pretests – conducted by comparing independently coded quality scores for a subsample of 20 reporting years (similarly to Gray, Meek, and Roberts (1995, 54)) – corroborate reliability, we cannot exclude the possibility that our results may suffer from weak reliability. Third, we introduce a new measure of disclosure quality. Even though this measure is based on existing theory and prior empirical findings, we acknowledge that the validity of our results may be impaired. Other studies assess validity by comparing their results with that of existing instruments (e.g., Lapointe-Antunes et al. (2006, 503)). This approach is not applicable due to the differing scope and construction of our index. We therefore encourage future researchers to develop other metrics in order to evaluate our approach and further promote discussion on an optimal metric for disclosure quality.

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Appendix A. Rules-based Intangible Disclosure Requirements under IFRS

In accordance with IAS 38.118, 122 and 124, firms have to disclose substantial information on intangibles in the notes. It is required to disclose whether additions are from internal development or acquisition (separately or through business combination), and whether the useful life is finite or indefinite. Further details that must be disclosed include the amortization methods and useful lives used for intangibles with finite useful lives, the (gross) carrying amount and any accumulated amortization, and impairment losses (reversed) and amortization recognized during the period (IAS 38.118). For material intangibles, the remaining amortization period has to be disclosed (IAS 38.122 (b)). Furthermore, disclosures regarding revaluated intangibles are required, especially the carrying amount of a hypothetical usage of the alternative cost model and the revaluation surplus (IAS 38.124).

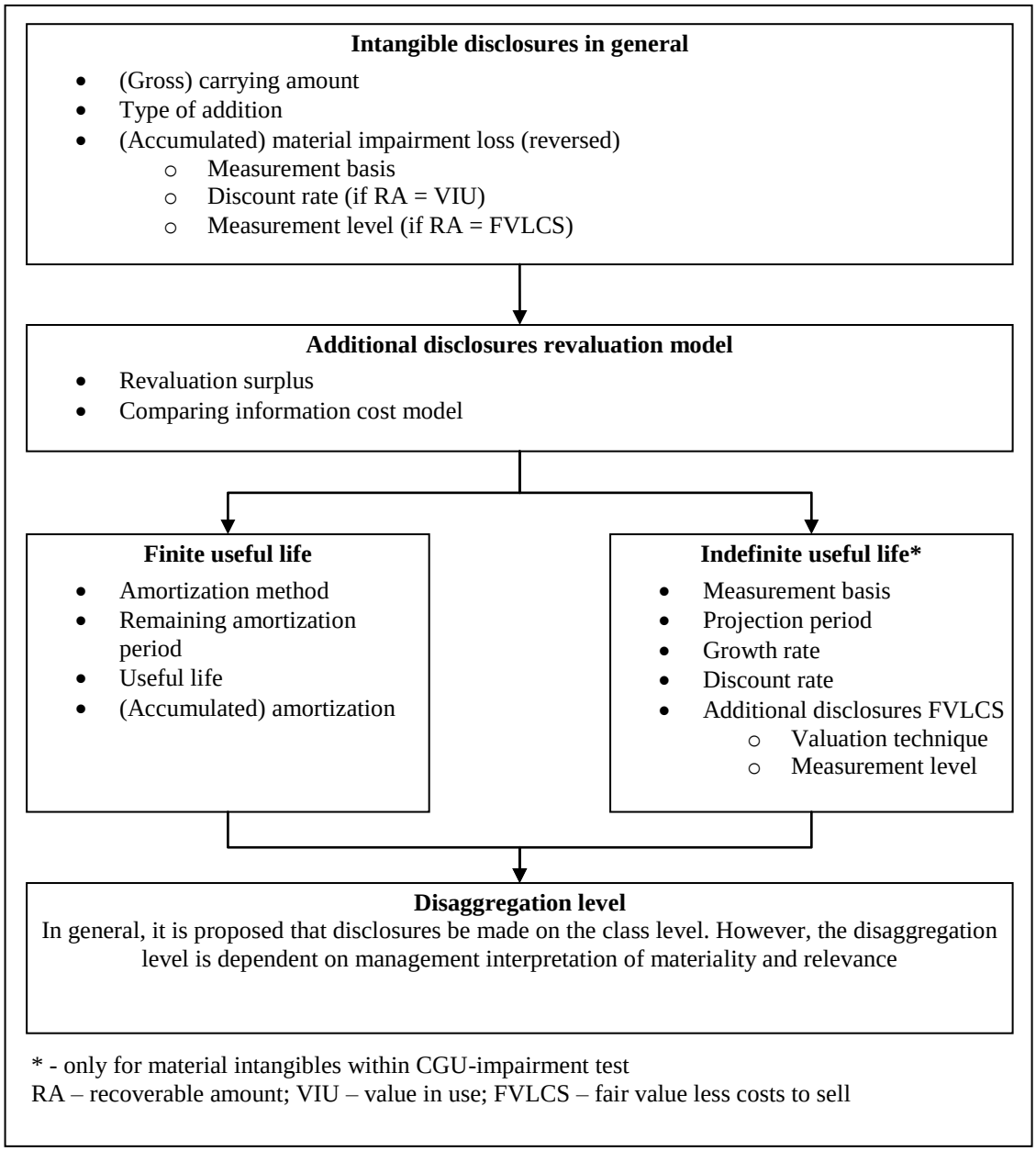
As long as a material impairment loss occurs, more disclosure requirements result from IAS 36. For assets with finite or indefinite useful lives, the measurement basis has to be disclosed, i.e. if the recoverable amount was determined on the fair value less costs to sell or the value in use (IAS 36.130 (e)). Furthermore, an entity has to disclose discount rates if the recoverable amount is represented by the value in use (IAS 36.130 (g)). Less information is required if the recoverable amount is the fair value less costs to sell. In that case only the measurement level has to be disclosed, i.e. the level of inputs used (IAS 36.130 (f)).[5] Detailed disclosures as demanded by IFRS 13.93, such as a description of the valuation techniques, need not be disclosed (IAS 36.130 (f)). Regardless of whether a material impairment loss has occurred, more detailed disclosures regarding the CGU-based impairment test are required for material intangibles with indefinite useful lives. In general, the measurement basis has to be disclosed (IAS 16.134 (c)). If the recoverable amount is based on the value in use, then the period of projecting cash flows, the growth rate used to extrapolate cash flow projections, and the applied discount rates have to be disclosed (IAS 36.134 (d)). Analogous disclosures are required if the recoverable amount is based on the fair value less costs to sell measured using discounted cash flow projections (IAS 36.134 (e) (iii)-(v)). Additionally, the disclosure of the valuation technique is required, i.e. the market, cost, or income approach (IAS 36.134 (e)). Furthermore, the measurement level shall be disclosed if it differs from level 1 (IAS 36.134 (e) (iiA)). Detailed disclosures as demanded by IFRS 13 are not required.

IFRS propose two different categorization approaches that differ at the disaggregation level. The first categorization approach groups intangibles into highly aggregated major classes such as marketing-, customer-, artistic-related as well as contract- and technology-based intangibles (IFRS 3 B64 (f) in conjunction with IE 18-44; similarly to Reilly and Schweihs (1999, 19–20)). The term 'major class' is not defined: IFRS only provide examples for each major class (IFRS 3 IE16). Due to the fact that this approach is described in the illustrative examples, the application is voluntary. Furthermore, it is only proposed for intangibles in relation to a business combination. The second categorization approach groups intangibles on a more disaggregated level into classes such as brand names, software, or patents (IAS 38.119). A class of intangibles is characterized by the similar nature and use these assets exhibit (IAS 38.119). In a second step, a separation into internally generated and purchased intangibles has to be done (IAS 38.118). This approach is mandatory, and applies to all intangibles (IAS 38.118).

These requirements, especially regarding the disaggregation level, are dependent on the interpretation of materiality and relevance (see e.g., IAS 38.119 and IAS 36.130). The disclosure requirements are presented in Figure A.1.

[5] From 2014 on, firms will have to disclose information to an equal extent as when using value in use (IAS 36 BC209E).

Figure A.1. Selected Disclosure Requirements for Intangibles, Mandatory during the Span of the Empirical Analysis (2008-2011)



Appendix B. Literature review regarding hypothesis development

Table B.1. Prior research on materiality of intangibles

Paper	Population	Design			Results	
		MN	MD	ST	AR	ER
Hager and Hitz (2007)	DAX[a)] N = 22[b)] 2005	x	-	-	6.81 %	-
Frey and Oehler (2009)	DAX N = 30[c)]	x	-	-	Indecisive	Steady increase (17.64 % to 21.94 %)
	N = 23[b) c)] 2005-2007	x	-	-	Steady increase (5.67 % to 7.58 %)	Steady increase (23.52 % to 28.43 %)
Frey (2010)	DAX[a)] N = 24[b) c)] 2005-2009	-	x	-	Steady increase (2.82 % to 5.63 %)	Steady increase (8.75 % to 20.14 %)

This table presents the results of prior studies that analyze materiality of identifiable intangible assets (intangibles). The populations feature the following restrictions: a) Results selected for DAX; b) results without banks / insurance companies; c) results for firms reporting under IFRS and US-GAAP. The "x" indicates one of the following characteristics, with the respective column given in parentheses: Mean values (MN); median values (MD); application of statistical tests (ST); intangibles-to-total-assets ratio (AR); intangibles-to-equity ratio (ER).

Table B.2. Prior research on intangible disclosures

Paper	Population	Disclosures	Design			Results
			GW	MA	ST	
Hager and Hitz (2007)	DAX[a)] N = 22[b)] 2005	IAS 38.118-126	-	x	-	Non-compliance Heterogeneous representation
Kirsch, Koelen, and Tinz (2008)	DAX N = 23 2005-2006	IAS 36.134-135	x	-	-	Non-compliance Heterogeneous content (across firms)
Frey and Oehler (2009)	DAX N = 30[c)] 2005-2007	Discount rates, growth rates, projection periods	x	-	-	Non-compliance Heterogeneous content (across firms) Increasing content
Frey (2010)	DAX[a)] N = 24[b) c)] 2005-2009	Discount rates, growth rates	x	-	-	Analogous to Frey and Oehler (2009)
Ruhnke and Schmidt (2013)	DAX, MDAX, SDAX N = 97[b)] 2010-2011	IAS 36.134 (d)-(f)	x	-	-	Non-compliance Increasing content
ESMA (2013)	Selected[d)] N = 235 2011	IAS 36.130 (d)-(e), IAS 36.134	x	x	-	Non-compliance

This table presents the results of prior studies that analyze disclosures of identifiable intangible assets (intangibles). The populations feature the following restrictions: a) Results selected for DAX; b) results without banks / insurance companies; c) results for firms reporting under IFRS and US-GAAP; d) European listed companies selected using several indicators; among others, a high proportion of intangibles to equity. The "x" indicates one of the following characteristics, with the respective column given in parentheses: No separate analysis of disclosures regarding identifiable intangible assets from Goodwill (GW); analysis of mandatory disclosures or adjustment for materiality (MA); application of statistical tests (ST).

Appendix C. Index construction

We differentiate between two information dimensions of disclosures, content and categorization (the CC score) as well as formatting (the FT score). The construction of the CC score is as follows. First, both the general categorization approach and the level of disaggregation are evaluated (*item 1*). Considering materiality as discussed in Section 4.2, we only include categorizations into our analysis that represent at least 10 % of the total intangible carrying amount. If intangible disclosures are categorized completely by following a consistent class-based approach, this is rewarded with 3 points. We also score firm-specific approaches that are equivalent to the IFRS approach depicted in Appendix A. Other class combinations are rewarded with fewer points, whereby a higher disaggregation level is assumed to be more useful, i.e. the categorization only into classes scores 2 points, while categorization into major classes scores 1 point. Incomplete and / or inconsistent approaches score 0 points. Second, for reconciliation disclosures (*items 2-5*), each disaggregation of total amounts – like the disaggregation of the total depreciation amount into amortization and impairment components – is scored with 1 point if disclosed, or 0 points if not disclosed. Firms that further allocate these amounts completely and conclusively to their respective material classes score another point. It is important to note that this additional point is independent of the evaluation of the general categorization approach done beforehand. Even if the firm follows an inconsistent categorization approach in general, e.g. one that differentiates between acquired and technology-based intangibles, we would score a disaggregation of carrying amounts to these categories if this is done completely and conclusively. Therefore, firms that use incomplete or inconsistent categorization approaches are penalized only once. Third, measurement disclosures (*items 6-11*) are scored analogously. If disclosures relate to at least one firm-specific class, this scores 1 point. If the disclosures are fully allocated, this scores 1 additional point. Following the requirements regarding understandability of information, we further calculate the FT score. If firms disclose information using tables or highlighted text, the previously achieved scores are duplicated. Altogether, the maximum disclosure quality score (the DQ score) achievable is 46, as depicted in Table C.1.

Table C.1. Construction of the disclosure quality index (DQ score)

#		Y_1	N_1	Y_2	N_2	Y_3 (Y_1>0)	Y_4 (Y_2>0)	N_3
	Complete categorization of gross and net carrying amounts following consistent material (...)			*Complete and conclusive allocation to material classes*		*Table or highlighted text presentation*		
1	(Major classes and classes),	3	0			3		0
	or (classes),	2	0			2		0
	or (major classes)	1	0			1		0
	Complete disaggregation of [...] regarding (...)							
2	[Gross and net carrying amounts] (finite vs. infinite useful lives)	1	0	1	0	1	1	0
3	[Accumulated and period-related depreciations] (amortization vs. impairment)	1	0	1	0	1	1	0
4	[Gross and net carrying amounts] (developed vs. acquired)	1	0	1	0	1	1	0
5	[Additions] (development vs. acquisition)	1	0	1	0	1	1	0
	Disclosure of [...] relate at least to one class							
6	[Useful life and amortization method]	1	0	1	0	1	1	0
7	[Measurement basis]	1	0	1	0	1	1	0
8	[Specific valuation method]	1	0	1	0	1	1	0
9	[Projection period]	1	0	1	0	1	1	0

Table C.1. Construction of the disclosure quality index (DQ score) – continued

#		Y_1	N_1	Y_2	N_2	Y_3 (Y_1>0)	Y_4 (Y_2>0)	N_3
10	[Growth rate]	1	0	1	0	1	1	0
11	[Discount rate]	1	0	1	0	1	1	0
	Max. sum	13		10		13	10	
	Max. CC score				**23**			
+	Max. FT score							**23**
=	Max. DQ score							**46**

This table presents the construction of the disclosure quality index (the DQ score). The index measures disclosure quality in the dimensions content and categorization (the CC score) as well as formatting (the FT score). The scoring model captures material information in two ways. First, only firms with an intangible-to-equity ratio of at least 10 % are selected. Second, only material classes and major classes that represent at least 10 % of the total intangible carrying amount are selected. In the case of firms without intangibles and with indefinite useful lives (*item 6*), the maximum score is adjusted.

Appendix D. Test design

The appropriate test design depends on several assumptions underlying statistical tests, especially the level of measurement and the distribution of data. As long as there is no reason to believe that these assumptions are violated, parametric tests are more powerful than non-parametric tests, and are therefore preferable (e.g., Sheskin (2011, 109)). In general, they require both an interval scale and a normal distribution of data. Starting with the level of measurement, our materiality proxy exhibits an unambiguous interval scale. In contrast, indices as applied in this study are more likely to exhibit an ordinal scale, since the weight of each scoring point is not assumed to be equal (e.g., Marston and Shrives (1991, 199); Sheskin (2011, 3)). However, several studies show that ordinal scaled data may not impair the power of parametric tests (for an overview see Marston and Shrives (1991, 200)). The second requirement, i.e. normality of data, is therefore essential for determining the test design. The central limit theorem suggests that the sampling distribution approaches normality as the sample size increases (Sheskin (2011, 154)). Prior research indicates normality of disclosure scores (e.g., Chow and Wong-Boren (1987); Cooke (1989); Gray, Meek, and Roberts (1995, 56)). Considering our unique index construction and our small sample size, we tested the normality assumption visually and formally using histograms, Q-Q plots and the Shapiro-Wilk test. Both the visual and formal tests reject normality in the case of our materiality proxy (p-value < 0.01). However, the results regarding the disclosure index are inconclusive. The formal tests reject the normality assumption with respect to the DQ score (p-value < 0.1) and the CC score (p-value < 0.05) in 2011. For all of the other index observations, including those of the FT score, no significant indication of non-normality is provided: a general rejection of the normality assumption is therefore lacking. Furthermore, the visual tests supported the assumption of normality.

Overall, we can conclude the following. Our materiality proxy clearly lacks normality, which is why we apply only non-parametric tests on related observations. Regarding our disclosure index, normality is indicated but not ensured in a statistical sense. Though parametric tests are usually robust (Sheskin (2011, 473–474)), we cannot exclude that non-normality may impair the validity of our results. Therefore, we apply both parametric and non-parametric tests to our disclosure index.