Review of Managerial Science
https://doi.org/10.1007/s11846-023-00630-3

REVIEW PAPER

Value relevance of voluntary intellectual capital disclosure: a meta-analysis

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Received: 8 May 2020 / Accepted: 13 February 2023

Abstract

Because mandatory disclosure of intellectual capital (IC) is restricted by accounting regulations, companies invest in voluntary IC disclosure (ICD) to reduce information asymmetries and support an adequate firm valuation by investors and other stakeholders. So far numerous studies analysing the value relevance of voluntary ICD have been published revealing mixed results. Thus, it is the purpose of this paper to statistically integrate and to explain the heterogeneity of results by applying a meta-analysis with 122 effects of 40 primary studies. Our results mainly support the value relevance of voluntary ICD resulting in higher market value, lower cost of equity, and higher accounting performance. We identify weak moderating effects for legal origin, different IC categories and journal ranking. For further improving of disclosure quality, standard setters should develop disclosure standards for voluntary ICD. To reduce the heterogeneity of future studies a standardised scale for the measurement of voluntary ICD should be developed and applied.

Keywords Intellectual capital · Voluntary disclosure · Meta-analysis · Financial effects · Moderating variables · Value relevance

JEL Classification M10 · M41

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Published online: 07 March 2023

1 Introduction

There is empirical evidence that expenditures and investments in intangibles such as licences, employee knowledge or brands are economically beneficial to firms in particular (Fraser et al. 2009; Heiens et al. 2007) and economies in general (Edquist 2011). Often, these intangibles are summarised as intellectual capital (IC) (e.g. Choong 2008). Despite its increasing relevance, accounting regulators have been reluctant to capitalize IC into firms' balance sheets, leading to information asymmetries especially for IC-intensive companies and decreasing value relevance of accounting information for investors (Basu and Waymire 2008; Ciftci et al. 2014; Hail 2013).

To compensate for shortcomings of mandatory disclosure, firms voluntarily disclose information about their IC. The rationale for voluntary IC disclosure (ICD) is the reduction of information asymmetries and thus of uncertainty in firm valuation. Overall, we can assume positive effects e.g. on a firm's market value, cost of capital or other outcomes of interest (Bismuth and Tojo 2008) and thus conclude value relevance of voluntary ICD. Nevertheless, voluntary ICD is costly and may lead to a leak of knowledge (Giacosa et al. 2017). In addition, Dumay (2012) argues that the main rationale for voluntary ICD often is not the reduction of information asymmetries but an alignment with industry standards. Both effects would counteract a value relevance of voluntary ICD.

To clarify this tension in understanding the value relevance of voluntary ICD, numerous studies have been conducted so far. In their literature review of studies analysing financial and non-financial effects of voluntary ICD, Vanini and Rieg (2019) found 34 results supporting the assumed positive effects and 13 non-supportive or negative results (see table ibid, V, p. 357). Voluntary ICD reduces information asymmetries between a firm's management and investors (Orens et al. 2010) resulting in lower cost of equity and of debt (e.g. Anifowose et al. 2017; Kristandl and Bontis 2007; Mangena et al. 2016; Orens et al. 2009). Contrary, for US–American firms the effect is only significant for the cost of equity. Orens et al. (2010) explain this result with differences in the relevant national accounting standards. In addition, the negative association between voluntary ICD and firms' cost of capital is not supported by La Rosa and Liberatore (2014) in their study of European firms from the biopharmaceutical and chemical industry. The results of studies examining the effect of voluntary ICD on market value of firms are even more mixed. For example, Orens et al. (2009) observe a positive relationship between voluntary ICD and the market value of listed firms from Belgium, France, Germany and the Netherlands, whereas Sáenz and Gómez (2008) and Castello Branco et al. (2010) find only insignificant effects. It is unclear which factors exactly cause this heterogeneity of results, be it sampling variances or differences in the measurement of voluntary ICD. Overall, Dumay and Garanina (2013) summarise that concerning potential effects of voluntary ICD "empirical and case evidence is inconclusive and far from achieving a solid scientific consensus." (ibid, p. 11).

The existence of such mixed results calls out for a quantitative integration of evidence by a meta-analysis. Variables for explaining inconclusive results are moderating factors originating from different study designs or other factors of interest such as the legal origin (La Porta et al. 2008). Unlike narrative reviews, meta-analyses are capable of statistically integrating effects, identifying variances of study results due to sampling or measurement errors and testing for potential moderating variables across studies (Buckley et al. 2014; Khlif and Chalmers 2015; Schmidt and Hunter 2014).

Given the inconclusive empirical results concerning the effects of voluntary ICD, this paper conducts a meta-analysis to develop a better understanding of moderating variables impacting the association between voluntary ICD and value relevance. Meta-analyses have not been extensively used in empirical accounting research so far (Khlif and Chalmers 2015; Velte 2019). To our best knowledge, a meta-analysis of the value relevance of voluntary ICD has not been conducted so far. Thus, the following research questions are addressed:

RQ1: What is the direction and strength of association between voluntary ICD and value relevance?

RQ2: Which are the moderating variables on the association between voluntary ICD and its value relevance?

In this paper, a meta-analysis of 40 studies is conducted. We integrate the correlation coefficients between voluntary ICD and various effects of value relevance and conduct subgroup analyses and meta-regressions based on various moderating variables such as legal origin characteristics.

The results indicate that voluntary ICD is value relevant and has positive effects such as an increase in market value or a decrease in the cost of equity. Nevertheless, the primary studies face several shortcomings such as a heterogeneous and non-standardised measurement of voluntary ICD offering opportunities for future research.

The paper contributes to the literature of voluntary ICD threefold: First of all, it statistically integrates results of 40 primary studies with 122 effects and thus complements and expands available narrative reviews (Cuozzo et al. 2017; e.g. Inkinen 2015; Vanini and Rieg 2019). Second, it identifies main influence factors on the value relevance of voluntary ICD. Third, it discusses the shortcomings of primary studies and thus reveals opportunities for future research. In sum, our paper contributes to reducing the uncertainty in the literature concerning the value relevance of voluntary ICD.

The paper is structured as follows: Sect. 2 provides a short literature review highlighting the empirical research concerning the value relevance of voluntary ICD and deriving hypotheses. Section 3 describes the meta-analytic methodology and selection of relevant studies. The results of the meta-analysis are described in Sect. 4 and discussed in Sect. 5. Also, implications for research and practice are derived and limitations revealed.

2 Prior research and hypotheses development

2.1 Value relevance of intellectual capital and IC disclosure

Despite ongoing discussions, the concept of intellectual capital (IC) is still not clearly defined, which leads to a variety of synonyms, like intangibles, intangible assets or intellectual property (for an overview see Abeysekera 2006; Choong 2008; Petty and Guthrie 2000). In our paper we use the notion intellectual capital (IC) and follow the definition of the IC pioneers Edvinsson and Malone (1997, p. 22): IC consists of "intangible assets […] that have no physical existence but are still of value to the company". Thus, IC has three relevant characteristics: (1) it is intangible, e.g. the skills or the knowledge of a firm's employees; (2) it is non-financial; thus, financial assets like securities are not included in the IC concept, and (3) it should contribute to the competitiveness and the value of a company.

Whereas intangible assets are basically identifiable and fulfil the recognition criteria of accounting standards such as IAS 38 to be capitalized in the balance sheet, the notion IC also includes intangible assets but is a broader concept as it also covers IC categories such as human capital or relational capital which are not capitalized in a firm's balance sheet. Nevertheless, these intangibles such as the qualification and experience of the employees might contribute to a firm's competitiveness and market value.

Although the share of intangible assets in firms' balance sheets has increased in Europe since IFRS implementation (Sahut et al. 2011), annual reports are considered incomplete concerning IC. Investments in human capital, relationships to customers or research projects often do not meet the IFRS identification and recognition criteria and are therefore immediately expensed in a firm's P/L (Canibano et al. 2000; Mouritsen et al. 2005). As economic benefits of IC typically occur in later periods, this leads to a distortion of the accounting principle of matching costs and revenues periodically and reduces the value relevance of mandatory accounting information about IC (Zéghal and Maaloul 2011; for empirical evidence see Basu and Waymire 2008; Ciftci et al. 2014; Hail 2013).

The non-capitalization of intangibles leads to an information asymmetry between a firm's management and potential investors, analysts and other stakeholders. To reduce the information asymmetry, companies have started to voluntarily disclose information about their IC to current and potential investors in conventional financial accounting statements, through event—and issue-specific disclosure, and in private constructs such as the value creation story and benchmarked intangibles (Holland 2003) which are communicated via private channels such as one-to-one meetings, presentations to analysts, or conference calls (García-Meca et al. 2005; Holland and Johanson 2003; Schiemann et al. 2011). IC information may be also disclosed in firm-specific IC statements (Mouritsen et al. 2004). However, studies show that very few firms produce and publish separate IC statements (Abeysekera 2006).

Nevertheless, perceived firm-specific benefits of voluntary ICD have to outweigh the costs of disclosure and create additional value for disclosing firms

(Alberti-Alhtaybat et al. 2012; Healy and Palepu 2001). Traditionally, value is defined as equity value and thus value relevance is the usefulness of accounting and non-accounting information for equity valuation (Barth et al. 2001; Holthausen and Watts 2001; Wyatt 2008). Therefore, the concept of value relevance and its measurement are often discussed from the perspective of capital markets. It is argued that value relevant information enables analysts and investors to reduce the uncertainty connected with firm valuation resulting in lower cost of capital and higher equity value (e.g. Dye 2001; Healy and Palepu 2001; Holland and Johanson 2003; Verrechia 2001).

Value relevance of voluntary ICD depends on the quantity and quality of information provided as both aspects are intertwined. While the quantity of information is a clear-cut construct, the quality dimension is not clearly defined in the literature. For example, Gao (2010) interprets disclosure quality as a reduction of noise (variance) of an information signal to investors so that investors can improve their investment decisions while other scholars consider it as a means for reducing information asymmetry in capital markets (Brown and Hillegeist 2007). Empirical studies often follow Guthrie et al. 2004 who suggest that voluntary ICD quality consists of extent, type of topics and relative emphasis of topics (whether quantified or not). Voluntary ICD is in other words a multidimensional and complex concept which needs to be measured along several dimensions like information extent, channels of information provision, periodicity, deadlines and more (Cavélius 2011).

2.2 Prior research

So far, numerous studies have analysed the value relevance of voluntary ICD (for an overview see Vanini and Rieg 2019). On the one hand, these studies indicate that analysts use voluntarily disclosed IC information for company valuation (e.g. Flöstrand and Ström 2006; Petty et al. 2008) and voluntary ICD seems to reduce analysts' forecast errors (Hsu and Chang 2011; Maaloul et al. 2016). Thus, analysts are more likely to follow firms and give favourable recommendations if they are better informed about these firms (e.g. Farooq and Nielsen 2014; Maaloul et al. 2016). The use of IC information by analysts seems to be positively influenced by firm size (Flöstrand and Ström 2006), profitability (García-Meca and Martínez 2007) and the informativeness of financial statements (Maaloul and Zéghal 2015). This finding is complemented by other studies indicating that analysts use IC information particularly to compensate for shortcomings of traditional financial reports about intangibles (e.g. Amir et al. 2003), to improve the stability of their creditworthiness judgements (e.g. Alwert et al. 2009), and to explain, contextualize and connect various financial information (e.g. Graaf 2013). Thus, voluntary ICD seems to reduce information asymmetries between a firm's management and its investors (Anifowose et al. 2017; e.g. Orens et al. 2010), resulting in lower cost of capital especially for European firms (Boujelbene and Affes 2013; e.g. Kristandl and Bontis 2007; Orens et al. 2009) and Japanese IPOs (Nielsen and Farooq 2015).

On the other hand, there is empirical evidence that the cost of equity increases for firms disclosing information about their R&D activities (La Rosa and Liberatore

2014). The authors explain their contradictory findings with the confidential nature of the disclosed information about a firm's innovation, patents and new technology. Here, capital markets seem to regard information disclosure as a risk because of the danger of disclosing confidential information to potential competitors which might lead to a loss of competitive advantages. In addition, R&D projects are considered as highly risky investments. Hence, investors might require additional risk premiums for investments in firms with an above average R&D intensity (for arguments and empirical support see La Rosa and Liberatore 2014).

Besides, the results of studies examining the effect of voluntary ICD on equity value are mixed. Orens et al. (2009) observe a positive relationship between voluntary ICD and the market value of listed European firms, whereas Saénz and Gomez (2008) and Castello Branco et al. (2010) find positive associations between voluntary ICD and equity value which fail to reach the required significance level. Singh and van der Zahn (2007, 2009) and van der Zahn et al. (2007) find a significant positive correlation between voluntary ICD and Singaporean IPOs' underpricing and a significant negative association with their post-issue stock performance.

Overall, "the benefits of ICD on increasing the company's profitability are not empirically proven" (Giacosa et al. 2017). Dumay (2016) even states that there is a wealth-creation myth of voluntary ICD. Holland and Johanson (2003) argue that due to knowledge problems analysts and investors might fail to understand the importance of certain intangibles, e.g. human capital investment, or are uncertain whether they could rely on the IC information (see also Abhayawansa and Guthrie 2010). Thus, Inkinen (2015) concludes that the answer to the question "Does IC systematically influence firm performance?' is far more complex to answer than with a plain 'yes'."

In sum, this tension in empirical evidence requires an integration of the results of studies investigating the value relevance of voluntary ICD. Unless the value relevance of voluntary ICD is empirically supported, firms should not devote resources to the disclosure. Also, the source of results' variability across studies must be identified.

2.3 Hypotheses development

According to agency theory, companies voluntarily disclose IC information to reduce information asymmetries between disclosing firms, information processors such as analysts and investors (Holland 2003) and thus to reduce agency costs associated with the separation of ownership and control (Castilla-Polo and Gallardo-Vazquez 2016). It is argued that value relevant information allows analysts and investors "to better monitor management and to make more accurate estimates of parameters underlying the future stock returns, decreasing the non-diversifiable estimation risk and the uncertainty about future cash flows and future profitability […]. Second, an enhancement in the extent of disclosure leads to lower transaction costs. Improved disclosure increases the likelihood for investors to trade, it increases the liquidity of firm's shares and decreases firm's cost of finance" (Orens et al. 2010, p. 1062; see also Healy and Palepu 2001). In sum, value relevant information supports

a more adequate and less uncertain forecast of future earnings of the disclosing firms resulting in a lower risk premium for investors and thus lower cost of capital and higher equity value (Healy and Palepu 2001).

Also, signalling theory states that—especially for IC-intensive firms—voluntary ICD is regarded as "good news" by capital markets and restrictive disclosure as "bad news" because it is assumed that firms only disclose information voluntarily if this information is positive. Thus, voluntary ICD can lead to a favourable reassessment of the firm and attract new investors by signalling attractive investment opportunities (An et al. 2011; Castilla-Polo and Gallardo-Vazquez 2016; Healy and Palepu 2001).

Hence, we postulate that voluntary ICD is value relevant as it reduces information asymmetry which in turn increases equity value as it is argued from agency theory and signalling theory.

Equity value is based on expectations and rational investors form their expectations on equity value through discounting future cash flows or net earnings (Damodaran 2012). Such a valuation includes cost of capital rates as well as cash flows or accounting returns as exemplified in the DCF model (Copeland et al. 2000) where equity value is a function of free cash flows discounted with weighted average cost of capital (WACC) net of market value of debt. Additionally, within a clean-surplus framework, accounting-based excess returns and free cash flows converge and lead to equivalent values of equity (Feltham and Ohlson 1995).

Regarding ICD and value relevance existing studies focus on market equity values, cost of capital as well as accounting returns (Vanini and Rieg 2019).

We differentiate in our analysis into these different types of financial outcomes—market value, cost of capital, and accounting returns—which are also related to different types of stakeholders involved and operationalize the broader research question 1. While for all stakeholders' disclosure can reduce information asymmetry, the interests and relationships between managers of a firm and other stakeholders are differing (Armstrong et al. 2010) and so are the expected effects of disclosure. Equity holders and debt holders face both information asymmetries, for example, but their interests and relationships with managers are different. Conflicts arise between them on dividend payments versus payoff of debt. Equity holders prefer high dividends, even if this means reduced financial resources to repay debt. Debt holders can prevent this with explicit debt contracts including covenants and they have often access to internal information which equity holders especially of listed firms do not (Armstrong et al. 2010). This means that we expect different information processing of voluntary ICD and, hence, different effects on stakeholder-specific financial outcome measures. Additionally, the signs of proposed effects are different for market value, accounting returns and cost of capital.

An improved transparency concerning the quantity and quality of a firm's IC should reduce information asymmetries and improve analysts' and investors' valuation approaches. Assuming that more investments in IC is related to additional voluntary ICD, we assume that voluntary ICD is positively associated with the expectations of analysts and investors about future firm success and thus leads to higher market values. Thus, we propose that voluntary ICD is value relevant for capital markets leading to higher market value and lower cost of capital for disclosing firms (e.g. An et al. 2011).

Hypothesis 1 There is a positive association between voluntary ICD and disclosing firms' market values.

In addition, voluntarily disclosed information about a firm's intellectual capital (IC) will reduce the valuation uncertainty of analysts and investors and lead to lower risk premiums and thus lower cost of capital (e.g. Dye 2001; Healy and Palepu 2001; Holland and Johanson 2003; Verrechia 2001). While cost of capital is a parent concept for cost of equity and cost of debt, it seems plausible to analyse them separately given the different stakeholders and their differing interests as discussed above. Contrary to the literature on corporate finance, studies on disclosure and accounting focus solely on either cost of debt or cost of equity and do not use weighted average cost of capital (WACC) as financial outcome (Healy and Palepu 2001). This seems plausible given differing interests, relationships and information asymmetries of equity and debt holders as highlighted above. Use of WACC would mix up two different stakeholder groups and therefore conceal different expected effects.

Hypothesis 2 There is a negative association between voluntary ICD and disclosing firms' cost of capital differentiated into cost of equity capital (H2a) and cost of debt (H2b).

Besides, resource-based theory states that a firm's sustainable competitive advantages and thus its future financial success are based on a unique development and combination of its resources (Barney et al. 2011). Especially, intangible resources such as IC contribute to a firm's competitive advantage and financial success, because they are difficult to develop and to imitate and—due to their non-rivalrous exploitation—long-lasting (Kristandl and Bontis 2007). This relationship is supported by various empirical studies (Albertini and Berger-Remy 2019). Therefore, we assume that voluntary IC disclosure is related to the existence of intangible resources and is associated with disclosing firms' profitability.

Hypothesis 3 There is a positive association between voluntary ICD and disclosing firms' financial success in terms of accounting measures.

The following Fig. 1 illustrates the hypotheses concerning the value relevance of voluntary ICD.

While one finds studies of the isolated effects of cost of capital (D'Mello et al. 2018) and accounting returns on market equity value (Lev 2001), an integrated analysis of the mediation of voluntary ICD on equity value through cost of capital or accounting returns as mediators is missing: while studies test the direct effect of voluntary ICD on market equity value, possible indirect effects are not empirically tested. Mediated regressions could highlight to which extent voluntary ICD contributes to market equity value directly as well as indirectly through mediators. That would provide a more detailed understanding of the mechanism at work for value generation through voluntary ICD which is to date restricted to the relation of voluntary ICD to market equity value (Curado et al. 2011).

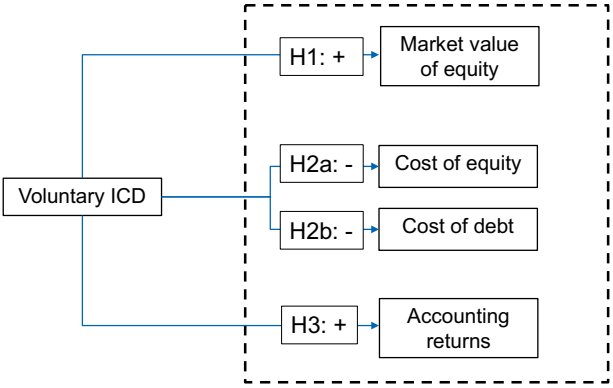

Fig. 1 Hypotheses concerning the value relevance of voluntary ICD

2.4 Moderating factors

Overall, various moderating factors might influence the value relevance of voluntary ICD. In accounting meta-analyses, variations of dependent and independent variable measures, firm characteristics, and research design-related variables are commonly used as moderating variables (Velte 2019). Here, the identification of moderating factors is done by reviewing relevant studies and prior narrative literature and methodological reviews (Buckley et al. 2014; Khlif and Chalmers 2015).

Legal origin: By creating accounting regulations fixing minimum disclosure requirements, regulators try to reduce information asymmetries. According to the theory of the political economy of accounting, there are significant differences in national accounting regulations leading to differences in information asymmetries between a firm and its stakeholders (Healy and Palepu 2001). Differences in value relevance of voluntary ICD are then associated with certain geographical areas (Castilla-Polo and Gallardo-Vazquez 2016). The differences in legal rules and regulations are accounted for to a significant extent by legal origins broadly defined as persistent systems of social control of economic life (La Porta et al. 2008). Roughly, two groups of legal origins can be differentiated: common law countries (e.g. Australia, Canada, India, South Africa, UK, US) und civil law countries which could be subdivided in French legal origin (Argentina, Belgium, Brazil, Chile, Cuba, Egypt, Arab Rep., France, Italy, the Netherlands, Russian Federation, Spain and others), German legal origin (Austria, Germany, Japan, Switzerland, China, Taiwan, South Korea, Poland and others) and Scandinavian legal origin (Denmark, Norway, Sweden, Greenland) (La Porta et al. 2008). Overall, empirical studies reveal that civil laws give investors weaker legal rights than common laws do (La Porta et al. 1998, 2008).

Legal origin is also directly connected to company laws and thus regulations such as accounting and disclosure rules and their enforcement (La Porta et al. 2008; for empirical support see La Porta et al. 1998). According to La Porta et al. (2008), we argue that in common law countries the accounting and disclosure regulation is

stronger in order to reduce information asymmetries between investors and a firm's management and thus enforce the protection of investors' rights.

Differences in value relevance of voluntary ICD can thus be associated with legal origin of the accounting regulation (Castilla-Polo and Gallardo-Vazquez 2016). In common law countries such as the US, disclosure practices of firms are more standardised and thus value relevance of voluntary disclosure is expected to be lower. Also, analysts and investors might access IC information from various sources and thus do not so much rely on one source (Botosan 1997). On the other hand, the value -relevance of voluntary ICD might be expected to be stronger for civil law countries.

Moderator 1 Value relevance of voluntary ICD is moderated by the legal origin.

IC category: Another moderating factor is the disclosed IC category. There are empirical indications that human capital supports other IC categories and thus voluntary disclosure of a firm's human capital might have a stronger impact than voluntary disclosure of a firm's structural or relational capital (Inkinen 2015; for empirical support see Albertini and Berger-Remy 2019). Contrary, due to its confidential nature voluntary disclosure of a firm's R&D activities might lead to negative results such as higher cost of capital (La Rosa and Liberatore 2014).

Moderator 2 Value relevance of voluntary ICD is moderated by the disclosed IC category.

Quality of publication: Due to the danger of publication bias, publication-quality is finally added as a moderator to our meta-analysis (see also Endrikat et al. 2020). A publication bias results from the observation that the probability of publication is higher for studies with statistically significant results than for studies with insignificant or negative results, especially in highly ranked journals (Carney et al. 2011; Rothstein et al. 2005).

Moderator 3 Value relevance of voluntary ICD is moderated by the quality of the publication outlet of a study.

Figure 2 summarizes the structure of effects we analyze as well as the hypotheses and moderator variables.

3 Methodology and sampling

3.1 Motivation for meta-analysis

During recent years, the number of studies in management research has exploded leading to an increasingly fragmented body of knowledge (Tranfield et al. 2003). Therefore, literature reviews have been applied to systematically integrate the results of different studies and to identify research gaps. Traditionally, literature

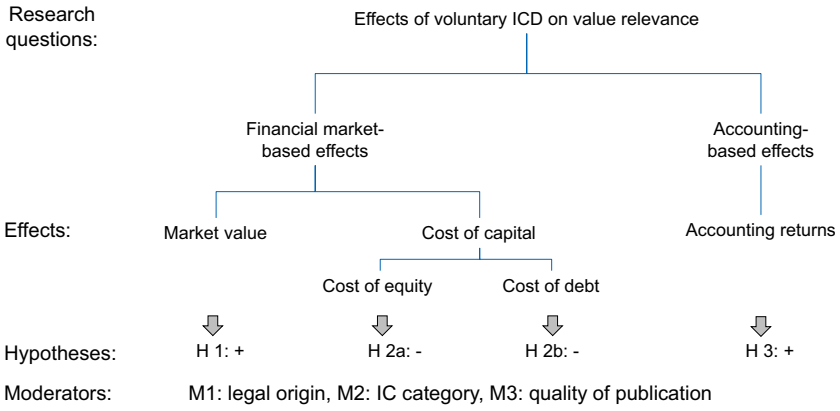

Fig. 2 Structure of effects, hypotheses and moderators

reviews in management science are more narrative and have been "widely criticised for being singular descriptive accounts of the contributions made by writers in the field, often selected for inclusion on the implicit biases of the researcher" (Tranfield et al. 2003).

Thus, simply counting positive and negative results is not a reliable procedure for integrating empirical results. Hence, over the last decades, meta-analytic methods were developed to integrate quantitative study results more reliably (Glass 1976; Schmidt and Hunter 2014). A meta-analysis allows the statistical integration of study results such as correlation coefficients and the estimation of summarised effects. Thus, the support or rejection of a hypothesis is grounded on a broader statistical basis and the statistical error type 2 is reduced. Also, effect variances can be explained by sub-group meta-analyses. Several approaches for meta-analysis are proposed in the methodological literature (for an overview see Schmidt and Hunter 2014). A main methodological difference exists in considering only sampling errors as sources of variance or additional biases of study artefacts like range restrictions of variables or imperfect reliability of constructs. As reliability coefficients were only provided for 46 out of 122 effects, we do not correct for study artefacts in our study.

The meta-analysis in this paper follows the steps recommended by Cooper et al. 2009; Havránek et al. 2020 and Clarke 2009:

1. Formulating a research problem, here: effects of voluntary ICD (Sect. 2)
2. Searching literature, here: studies on effects of voluntary ICD (Sect. 3.2)
3. Coding the literature (Sect. 3.3)
4. Statistically describing study outcomes, here: use of correlation coefficients (Sect. 3.5)
5. Statistically combining effect sizes by weighting of studies and correcting for study artefacts, here: meta-analysis and meta-regression (Sect. 3.5)

Additionally, we prepared a technical appendix that explains these steps with an example.

3.2 Literature research and inclusion criteria

During data collection, relevant studies must be extracted. Although there is no general rule how many studies should be included (Cooper 2010), a comprehensive, broad, and unbiased literature search is regarded as an important success factor of a meta-analysis. A well-conducted meta-analysis searches potential studies in multiple databases, as a limited pool of studies might bias the conclusions (Buckley et al. 2014). To identify relevant studies, several complementary search strategies were combined (Endrikat et al. 2020). A query of titles, abstracts and keywords were conducted in several literature databases,[1] using the search terms "intellectual capital" and "disclosure", partly in combination with "effects", "cost of capital" or "market value". The findings were checked via Google Scholar and cross-checks in the reference lists of the reviewed articles (for a similar procedure see Endrikat et al. 2020). A period from 2000 to 2019 was covered.

Based on a full-text analysis it was evaluated if the studies fulfilled the following inclusion respective exclusion criteria:

- As we focus on the value relevance of voluntary ICD, studies analysing mandatory disclosure or indicators based on accounting numbers such as the VAIC were not considered (e.g. Zéghal and Maaloul 2010).
- Case and field studies were excluded (e.g. Abeysekera 2014). Case studies in ICD research try for example to shed light on the production or usage of IC information (e.g. Veltri and Bronzetti 2015). Given that case and field studies aim to understand phenomena in-depth they typically do not provide and are not designed to deliver data sets suitable for statistical analyses such as correlation coefficients or standard errors (Yin 2009) and therefore cannot be integrated in a meta-analysis.
- Also, studies had to use voluntary ICD as independent variable and measures of value relevance such as cost of equity as dependent variables. As a result, studies analysing determinants or characteristics of voluntary ICD were excluded (e.g. Li and Mangena 2014).
- Meta-analyses require a common effect size to represent the quantitative results of the studies (Buckley et al. 2014). Thus, the studies had to report their sample sizes, correlation coefficients or other appropriate effect sizes.
- The studies had to be published in English.

As multiple coder-coding reduces the bias associated with a single coder (Buckley et al. 2014), one researcher coded all articles. Afterwards, the coding was checked by a second researcher. Because of the limited number and the similarities in the research design of the researched papers, only a few differences in coding occurred and were solved by discussions between the two researchers. This means

[1] The following databases were used: Business Source Complete, Abi Inform Global, Springer Link, JSTOR, EconBiz, ECONIS, Science direct, Social Science Research Network, Taylor and Francis, Emerald Insight, Elsevier and Wiley.

Table 1 List of variables and codings

Variable-group	Single variables: code
Dependent variables: Measures of value relevance of voluntary ICD	A.1 market value (market-to-book ratio, share price, Tobin's q) A.2 cost of capital (A.2a cost of equity, A2b cost of debt) A.3 accounting performance (RoE, profit, growth)
Independent variables: Voluntary ICD	Extent of voluntary ICD
Moderator 1: legal origin	MV 1 legal origin (MV 1.1 common law countries, MV 1.2 civil law countries)
Moderator 2: IC category	MV 2 IC category (MV 2.1 Human Capital, MV 2.2 Relational Capital, MV 2.3 Structural Capital, MV 2.4 other IC)
Moderator 3: Quality of publication outlet	MV 3: Ranking of journals according to the ranking provided by VHB Jourqual 3 (MV 3.1, ranked MV 3.2. not ranked)

also, that more complex coding, where researchers try to extract meaning from texts (e.g. Krippendorff 2013), was not applied and corresponding measures of intercoder reliability like Krippendorff's alpha were not calculated.

In the end, a final group of 40 papers analysing 122 measures of value relevance of voluntary ICD was extracted for the meta-analysis (see Appendix 1). Compared to other meta-analyses in accounting (Khlif and Souissi 2010 analysed 16 studies; Souissi and Khlif 2012 investigated 22 studies; Eddine et al. 2015 investigated 19 studies), our meta-analysis appears to be quite comprehensive. In general, the unit of analysis is the individual study. However, the majority of studies analysed multiple effects on the value relevance of voluntary ICD.

3.3 Definition of variables and coding

Data preparation includes the coding of studies, calculation of effect sizes and identification of moderating variables (Buckley et al. 2014). Thus, the following coding system was developed and tested (Table 1).

3.3.1 Dependent variables

The dependent variables cover the various measures of value relevance of voluntary ICD. Value relevance is defined as the usefulness of accounting and non-accounting information from the perspective of a firm's shareholders for equity valuation. If IC information is considered as value relevant, we broadly grouped the effects for shareholders in market value, cost of equity, cost of debt and accounting returns (see Fig. 1) and measure them with respect to capital markets such as a firm's market value, market-to-book ratio, cost of capital or stock price. Also, financial effects can result in accounting-based outcomes such as a firm's return on assets or on equity or its turnover growth (for a similar classification see Albertini and Berger-Remy 2019).

3.3.2 Independent variables

As independent variables, we searched for voluntary ICD in total as well as for specific categories like human, relational or structural capital. Reviews of studies analysing influence factors and characteristics of (voluntary) ICD have shown that these studies mainly use content analysis to evaluate the extent of IC disclosure (Abeysekera and Guthrie 2005; Bozzolan et al. 2003; Brennan 2001; Guthrie et al. 2004; e.g. Guthrie and Petty 2000). Content analysis is a method for data collection by subjective coding of qualitative data in categories. It allows analysing and counting the type, volume and quality of information disclosed in annual financial reports or other publications such as analysts' reports or press releases (Ienciu 2014). Based on content analysis most studies calculated an index of voluntary ICD (Dumay and Cai 2015) which provides a basis for the quantitative analysis of qualitative ICD information (Abeysekera 2006). An alternative to content analyses of documents is to measure voluntary ICD with questionnaires in surveys (Cuozzo et al. 2017).

It seems self-evident that it is not the quantity of information itself that is useful for shareholders but the quality and quantity of voluntary ICD provided. Guthrie et al. 2004 suggest that useful voluntary ICD is as a mixture of quantity and quality aspects: extent, type of topics, and relative emphasis of topics. In that sense, voluntary ICD is seen as a multidimensional and complex concept which needs to be measured in several dimensions (Cavélius 2011) and we would expect to find discussions on that in the studies to be analysed.

3.4 Moderating variables

For the first two moderators, legal origin and IC categories, we follow La Porta et al. 2008 and Khlif and Chalmers (2015). Similar to La Porta et al. (2008) we differentiate between civil law countries (e.g. Germany, France, Brazil, Switzerland etc.) and common law countries (e.g. the US, the UK or Canada).

Besides, IC cannot be regarded as a homogenous concept but consists of different categories for which different financial effects may be derived (Castilla-Polo and Gallardo-Vazquez 2016). Thus, voluntary ICD can be analysed in total or concerning its various components. Although the literature suggests many different categorizations of IC (Choong 2008), we use the wide-spread categorisation differentiating between human capital (intangibles related to personnel), relational capital (intangibles derived from a firm's external relationships) and structural capital (intangibles associated with a firm's internal organisation) (Edvinsson and Malone 1997, for a discussion, see Castilla-Polo and Gallardo-Vazquez 2016, for an application in meta-analysis see Albertini and Berger-Remy 2019).

Finally, we use publication quality as a research-specific moderator and follow the approach of Endrikat et al. (2020). We use the journal ranking provided by the VHB Jourqual 3 to evaluate the quality of the publication outlet, as this is an internationally recognized and comprehensive journal ranking (Harzing 2019).

3.5 Meta-analytic procedures

3.5.1 Estimation of true effects

Meta-analyses combine effect sizes and estimate distribution and variation of combined effect sizes, allowing for examining homogeneity and effects of moderating variables. Combining effect sizes relates to a hierarchical statistical model that includes single studies on the lowest levels and variation of studies at the upper level.

To estimate the mean correlation coefficients and the related standard deviation, we transformed all correlation coefficients into Fisher z-values. This is advised because standard errors of correlations depend on the correlation coefficient itself instead of sample size (Borenstein 2009). Then, the following meta-analysis reports correlation coefficients transformed backwards from Fisher z-values.

Since a standard deviation of an effect is only a point estimate and repeated measurement could result in different point estimates, it is a good statistical practice to report confidence intervals (CI) of effect sizes. Here, we report the usual 95% confidence intervals.

Cumulating evidence of studies can be done with a fixed-effect model, that assumes the same underlying true effect in all studies, or a random-effect model assuming differently measured effects (Borenstein et al. 2017; Hunter and Schmidt 2000). Given a variety of approaches to measure voluntary ICD and various financial results of voluntary ICD, we applied a random-effect model typically leading to wider confidence intervals.

Meta-analysis requires statistically independent samples. We can assume statistical independence if the samples come from different national backgrounds. If several publications were based on one data set, we only used one paper to avoid overrepresentation (see e.g. Reed 2000; Reed et al. 2006). Our meta-analysis also excluded studies with insufficient data to calculate effect sizes. Since some studies contain measurements of several sub-components and effect indicators, the total number of effect sizes exceeds the number of studies. Like Albertini and Berger-Remy (2019) we consider the k number of associations in a study as independent, as previous research suggests that this approach leads to better results than single-value approaches (Bijmolt and Pieters 2001). To give an appropriate picture of results, we include the number of studies as well as the number of effects in the result tables.

3.5.2 Detecting heterogeneity in true effects

In the context of meta-analysis studies are said to be homogeneous if the differences between observed effects are solely caused by sampling variances due to different sample sizes. This implies that all studies included in the meta-analysis measure the same underlying true effect (Viechtbauer 2007). In contrast, heterogeneity in a meta-analysis refers to the variance of true effects, often called tau^2 (Viechtbauer 2010). Such variance stems from substantial differences between studies like differences in measurement, sample selection and others. In a meta-analysis the estimation of the true effect is performed in a two-step approach. First, the unknown variance tau^2

has to be estimated with an a priori chosen estimation method (Viechtbauer 2005). Then, based on the estimated tau^2 the studies at hand are aggregated with a weighted average with weights equal to $1/(v_i + tau^2)$, where v_i is the variance of an individual study. The resulting estimated true effect depends then on the choice of the estimation method which introduces potential biases and some degree of arbitrariness (Veroniki et al. 2016; Viechtbauer 2005).

Several statistics and metrics exist for assessing heterogeneity in meta-analytic results (Borenstein et al. 2009; Higgins 2008; Roever 2020; Viechtbauer 2010):

- Test for the existence of heterogeneity which is typically a test of the null hypothesis that all studies share a common effect size or—in other words—are homogeneous. The metric for this test, Q—df, is the relative excess variation attributable to differences in the true effect from study to study. A statistically significant p-value indicates that the true effects vary in the studies included.
- Assessing the magnitude of heterogeneity in absolute terms which is apparent in the estimated true effect and its confidence interval as well as in the variance of the true effect, tau^2. This is the preferred and most important metric for assessing heterogeneity (Rücker et al. 2008; Viechtbauer 2007).
- Assessing the magnitude of heterogeneity in relative terms which is often estimated as proportion of observed variance that reflects real differences, I^2, on a range of 0 to 100% (Higgins and Thompson 2002). Larger values indicate larger differences between studies not attributable to sampling error. A value of I^2 below 40% might indicate an unimportant heterogeneity, while a value of I^2 over 75% might be seen as considerable heterogeneity (Higgins et al. 2021). Yet, it does not inform about the absolute heterogeneity which is often incorrectly associated with it (Borenstein et al. 2017; Rücker et al. 2008).
- Using forest plots to visualize heterogeneity. This allows for a direct identification of outliers, i.e. studies with rather extreme results that might influence the overall estimated effect in an unduly way (Ruppar 2020).

3.5.3 Analysing heterogeneity in true effects

Once identified through the metrics and statistics above, heterogeneity needs further analyses to understand its causes. Large heterogeneity may indicate possible moderators as discussed above or not yet detected differences between studies. Such moderators, and sub groups as well, indicate possible systematic deviations of true effects between studies (Viechtbauer 2007). Ex ante defined moderators (Sect. 3.4) are used to divide the total sample of studies into subgroups corresponding to the coded categories for the moderator and a meta-analysis was performed for each sub-group. When the mean correlation coefficients differ substantially between the subgroups and the variance is lower in the subgroups than in the overall analysis, a moderating effect is assumed (Schmidt and Hunter 2014). We perform two statistical tests for answering two different questions: the first test evaluates if mean effect sizes of subgroups and moderators in the subgroups deviate from zero, i.e. a null hypothesis that coefficients are zero; second, a test if the mean effect size of moderators deviate from the mean effect size of the subgroup in total. The null hypothesis in this case is that both

coefficients are the same. This is done with a likelihood ratio tests (LRT) (Viechtbauer 2010) that compares two models, the subgroup with all effects and the subset for a specific moderator.

We add meta-regressions (Sect. 4.3) which answer a third question: which moderators are in a set of several moderators statistically significant? Meta-regressions use the effects of studies as dependent variables and—in our case—categorical moderators as independent variables in a random-effects model (Borenstein et al. 2009). The main differences of a meta-regression based on study effects as data points from a regression in primary studies are: (1) the level of analysis is the study (effects per study) not the subjects (firms, individuals), (2) like in aggregating studies in a meta-analysis, assigning a weight for each study effect is needed, and (3) the decision between a fixed- and a random-effects model has to be made (Borenstein et al. 2009). In accordance with the meta-analysis described before, we use effects and effect variances of primary studies and employ a random-effects model for meta-regression, too.

If the defined moderators are not sufficient to explain heterogeneity, a retrospective analysis of differences in studies that still show divergent effects is helpful. New moderators or other possible causes for differences can thus be discovered.

3.5.4 Publication bias

Finally, we accounted for publication bias. First, we researched for unpublished papers. However, we could not identify such papers. To evaluate a possible publication bias we include funnel plots. An asymmetric shape in the funnel plot would hint on a possible publication bias (Schmidt and Hunter 2014). Formal tests for funnel plot asymmetry are also performed, which are the rank correlation test (Begg and Mazumdar 1994) and the regression test (Sterne and Egger 2005).

The statistics was performed using R and the software package „metafor" in its latest version (Viechtbauer 2010).

4 Results

4.1 Descriptive statistics

Figure 3 indicates the timeline of published studies with peaks in 2007, 2013, and 2017. Also, we see a clear national concentration of studies in the United States and Taiwan. Moreover, some mixed samples are covering several countries. Table 2 depicts descriptive statistics for studies and effects. Sample sizes vary strongly between 25 and 1200, also the number of effects per study, which lies between 1 and 15.

4.2 Meta-analytic results

Table 3 summarizes the results for the value relevance of voluntary ICD in general—integrating all effects regardless of their measurement. Overall, we find for 40 studies with 122 effects a small positive value relevance of voluntary ICD.

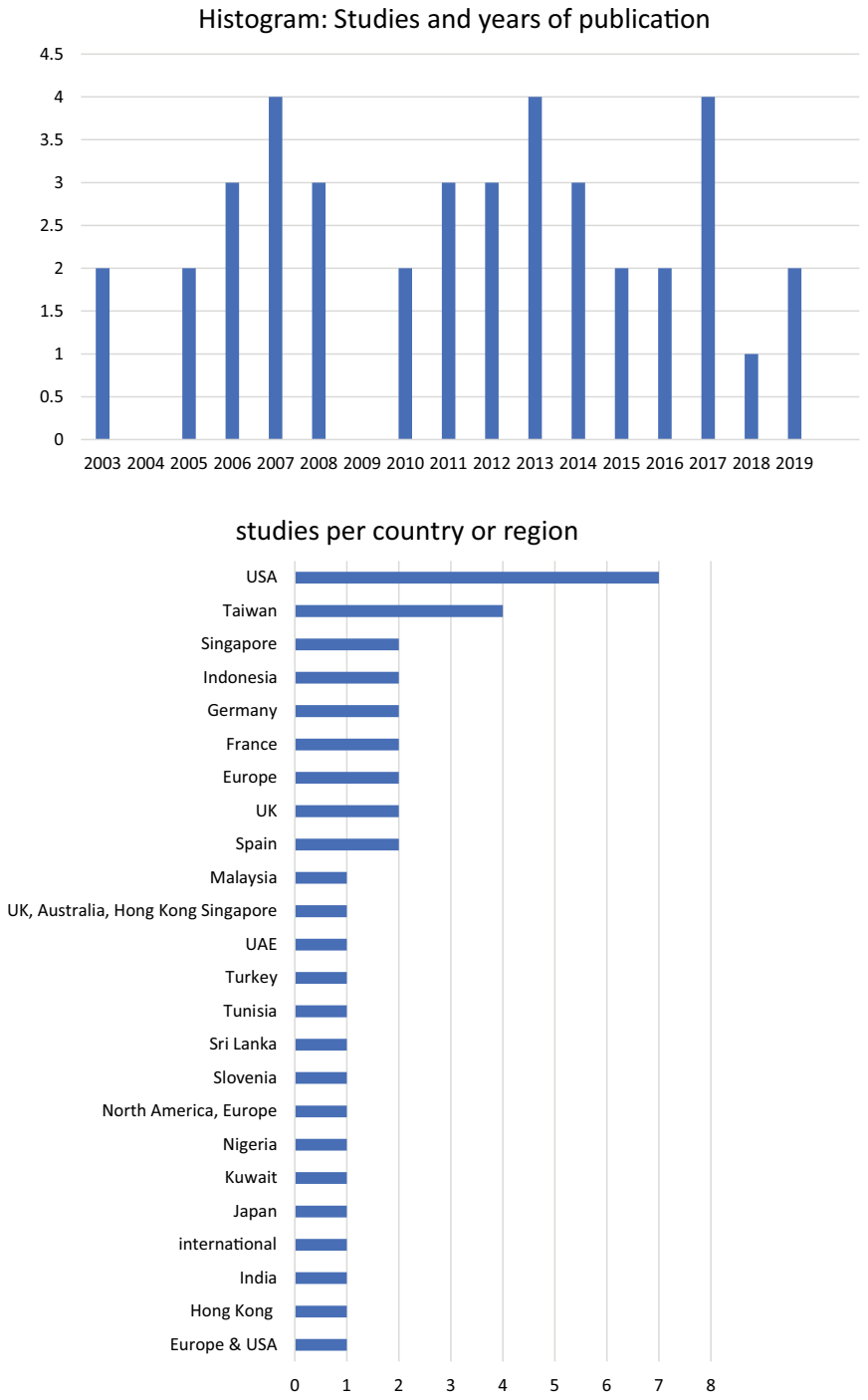

Fig. 3 Studies per year and country or region

Table 2 Descriptive statistics

descriptive statistics	sample sizes	no. of effects per study	effect sizes (correlations)
min	25	1	-0.411
max	1200	15	0.661
mean	175.49	2.62	0.072
median	123.00	2	0.070
total	8248	122	

moderator variables			
legal origin		ranked publication	
common law	59	ranked	78
civil law	54	not ranked	44
n/a*	9		
total	122		122
*) studies which focus on diverse set of countries/regions			

The I^2 statistic indicates a large heterogeneity which seems not surprising given the effects of different sub groups that are grouped together. Moderators do not exert significant impact on this level of analysis.

Figure 4 summarizes the results for the associations between voluntary ICD and diverse measures of market value (hypothesis H1), as well as subgroup analyses regarding the moderating variables. We found 23 studies analysing 42 effects. In general, there is a positive combined effect of voluntary ICD on market value, as postulated (e.g. Abdolmohamadi 2005; Flöstrand 2006; Vafaei et al. 2011), yet a small one. The mean effect is larger for IC sum (0.185, LRT $p = 0.063$) and for not ranked publications (0.258, LRT $p = 0.069$). The I^2 statistic indicates a large heterogeneity of effect sizes which is apparent in the forest plot with 31% of effects which are negative and hence contrary to the hypothesis. On the other hand, some studies like Anam et al. 2011; Uyar and Kılıç 2012 document unusually high positive effects. Given that both studies rely on content analysis of annual reports and market capitalization as dependent variable, which is also an outcome often used, the results might be caused by the specific samples of countries selected by studies and therefore, by the legal origin.

Figure 5 shows results for hypothesis 2a, the mean effect of voluntary ICD on the cost of equity. The results support the postulated negative effect direction, so voluntary ICD reduces cost of equity capital (Anifowose et al. 2017; e.g. Kristandl and Bontis 2007; Orens et al. 2009). The effects are stronger in countries with common law (−0.276, LRT $p = 0–073$). Nearly all confidence intervals are below zero which gives additional support for hypothesis 2a.

Table 3 Results for the value relevance of voluntary ICD

Value relevance of voluntary ICD (all studies)	No. of studies	Total sample size	No. of effects k	Mean effect correlation	Standard error	*p* value	95% confidence interval		Heterogeneity	Likelihood ratio test comparing to mean effect	
							lower limit	upper limit	I^2 [%]		
	40	7273	122	0.116	0.016	<0.001	0.085	0.148	80.10	Test statistic	*p*-value
Moderator 1											
Common law	17	3756	59	0.116	0.024	<0.001	0.069	0.162	84.45	0.007	0.935
Civil law	20	3229	54	0.132	0.025	<0.001	0.084	0.179	74.13		
Moderator 2											
IC in sum	25	3713	45	0.121	0.030	<0.001	0.062	0.179	79.78	0.000	0.984
Human capital	14	3507	23	0.111	0.032	<0.001	0.049	0.171	75.16	0.049	0.824
Relational capital	12	2533	16	0.157	0.045	<0.001	0.071	0.241	75.95	0.951	0.329
Structural capital	13	2897	18	0.099	0.035	0.005	0.031	0.167	69.94	0.245	0.620
Other IC	5	1319	18	0.102	0.047	0.030	0.010	0.192	88.54	0.148	0.701
Moderator 3											
Ranked publications	25	6253	78	0.119	0.018	<0.001	0.084	0.153	80.04	0.051	0.820
Not ranked publications	15	1643	44	0.111	0.034	0.001	0.045	0.175	76.72		

Random-effects model, Q-test for heterogeneity (df = 121) = 611.79, $p < 0.01$; absolute heterogeneity $tau^2 = 0.02$, relative heterogeneity $I^2 = 80\%$

Hypothesis H1 Effect of voluntary ICD on market value		no. of studies 23	total sample size 3461	no. of effects k 42	mean effect correlation 0.132	standard error 0.041	H0 coeff=0? p value 0.001	95% confidence interval lower limit 0.053	 upper limit 0.209	Heterogeneity I^2 [%] 90.01	Likelihood ratio test comparing to mean effect test statistic	 p-value
Moderator 1	common law	10	1723	18	0.119	0.059	0.043	0.004	0.23	90.13		
	civil law	11	1759	17	0.186	0.073	0.010	0.045	0.32	92.38	0.087	0.767
Moderator 2	IC in sum	18	1988	28	0.185	0.050	0.000	0.089	0.278	86.38	3.466	0.063
	human capital	4	780	4	0.023	0.039	0.490	-0.043	0.089	4.99	1.052	0.305
	relational capital	3	404	3	0.092	0.091	0.312	-0.086	0.264	62.16	0.040	0.842
	structural capital	2	404	3	0.041	0.110	0.707	-0.173	0.253	0.00	1.289	0.256
	other IC	2	861	4	-0.001	0.208	0.997	-0.391	0.390	98.47	1.301	0.254
Moderator 3	ranked publications	15	2922	31	0.089	0.039	0.023	0.012	0.166	87.12		
	not ranked publications	8	875	11	0.258	0.110	0.017	0.048	0.446	91.45	3.311	0.069

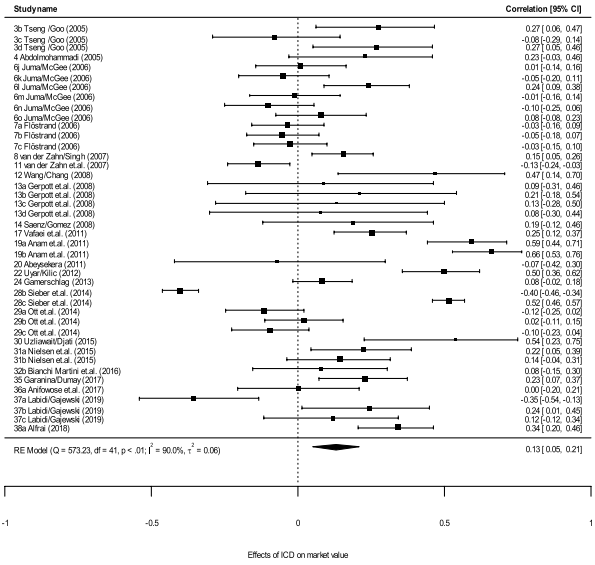

Fig. 4 Results for hypothesis H1: effects of voluntary ICD on market value. Random-effects model, Q-test for heterogeneity (df = 41) = 573.22, $p < 0.01$; absolute heterogeneity $tau^2 = 0.06$, relative heterogeneity $I^2 = 90\%$

Hypothesis H2b postulates a negative effect of voluntary ICD on cost of debt. Figure 6 shows that there are only four studies with ten effect sizes analysing this relationship. The mean effect is nearly zero and statistically not significant. It follows that the results do not support hypothesis H2b. Given the small number of effects a further sub-group analysis would not lead to additional insights.

Figure 7 summarizes the results for hypothesis 3, the effect of voluntary ICD on accounting returns. The mean effect is as postulated (e.g. Reed et al. 2006). The heterogeneity I^2 (81%) indicates real differences between studies, but it does not affect the overall conclusion because only 13.6% of all effects are negative. The mean effect is larger for countries with civil law (0.266, LRT $p = 0.014$), relational capital (0.294, LRT $p = 0.023$) and non-ranked publications (0.309, LRT $p = 0.009$).

Overall, our results support hypotheses H1, H2a and H3. Voluntary ICD exerts clear effects on various types of outcomes as reported above, except for cost of debt (H3b). Hence, voluntary ICD is in general value relevant. Nevertheless, some correlation coefficients are quite small, as other variables are contributing to various effects.

Besides, the heterogeneity of the studies is quite strong and suggests the presence of moderators. The first analysed moderator is legal origin. The effect of

Hypothesis H2a		no. of studies	total	no. of effects	mean effect	standard	H0 coeff=0?	95% confidence interval		Heterogeneity	Likelihood ratio test	
Effect of voluntary ICD on			sample size	k	correlation	error	p value	lower limit	upper limit	I^2 [%]	comparing to mean effect	
cost of equity		**9**	**2121**	**23**	**-0.192**	**0.033**	**< 0.001**	**-0.254**	**-0.128**	**62.77**	**test statistic**	**p-value**
Moderator 1	common law	3	342	6	-0.276	0.048	0.000	-0.36	-0.188	37.58	3.225	0.073
	civil law	4	1111	16	-0.143	0.041	0.001	-0.221	-0.063	54.79		
Moderator 2	IC in sum	7	1421	10	-0.183	0.056	0.001	-0.286	-0.076	0.72	0.034	0.853
	human capital	3	266	4	-0.174	0.086	0.042	-0.332	-0.007	0.51	0.054	0.817
	relational capital	3	211	4	-0.124	0.099	0.211	-0.308	0.070	0.63	0.800	0.371
	structural capital	3	266	4	-0.294	0.058	< 0.001	-0.394	-0.186	0.00	1.837	0.175
	other IC	1	700	1	-0.198	0.038	< 0.001	-0.268	-0.126	0.00	0.003	0.958
Moderator 3	ranked publications	4	1588	5	-0.163	0.091	0.070	-0.330	0.014	0.91	0.131	0.717
	not ranked publications	5	492	18	-0.201	0.036	0.000	-0.267	-0.133	0.41		

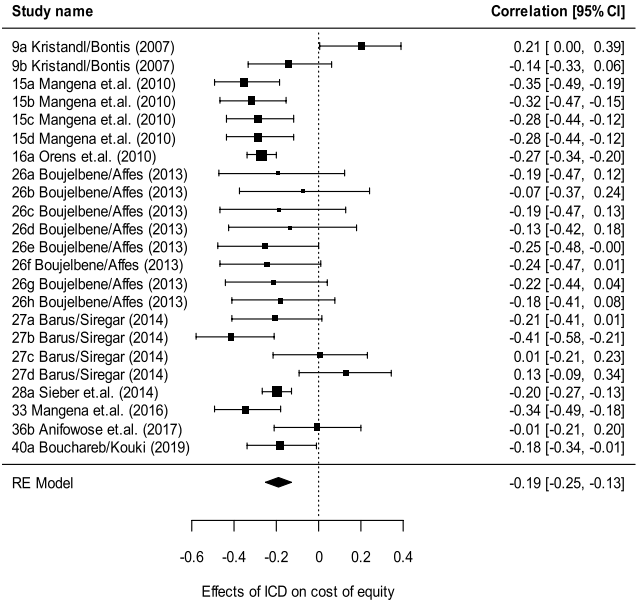

Fig. 5 Results for hypothesis H2a: effects of voluntary ICD on the cost of equity. Random-effects model, Q-test for heterogeneity: (df = 22) = 50.16, $p < 0.01$; absolute heterogeneity $tau^2 = 0.01$, relative heterogeneity $I^2 = 63\%$

voluntary ICD on cost of equity (H2a) is stronger for common law countries (r = −0.276, $p < 0.01$, LRT $p = 0.073$). In contrast, for accounting returns (H4) the effect is stronger for civil law countries (r = 0.266, $p < 0.01$, LRT $p = 0.014$).

The second analysed moderator is the disclosed IC category. Our results only partly support this moderator. IC sum exerts a stronger mean effect for market value (r = 0.185, $p < 0.001$) and is significantly different from the main effect (LRT, $p = 0.063$). Relational capital has the strongest positive association with the disclosing firm's accounting returns (r = 0.294, $p < 0.001$). This effect is also significantly different from the overall effect in the subgroup (LRT, $p = 0.023$).

The third moderator, ranked publication, indicates stronger effects for the sub group market value (H1) for non-ranked publication outlets with r = 0.258, $p = 0.02$ (LRT $p = 0.069$) and in the sub group accounting returns (H4) for non-ranked publication outlets with r = 0.309 ($p < 0.01$, LRT $p = 0.009$).

Hypothesis H2b Effect of voluntary ICD on	no. of studies	total sample size	no. of effects k	mean effect correlation	standard error	p value	95% confidence interval lower limit	95% confidence interval upper limit	Heterogeneity I^2
cost of debt	4	956	10	-0.035	0.040	0.381	-0.114	0.044	39%

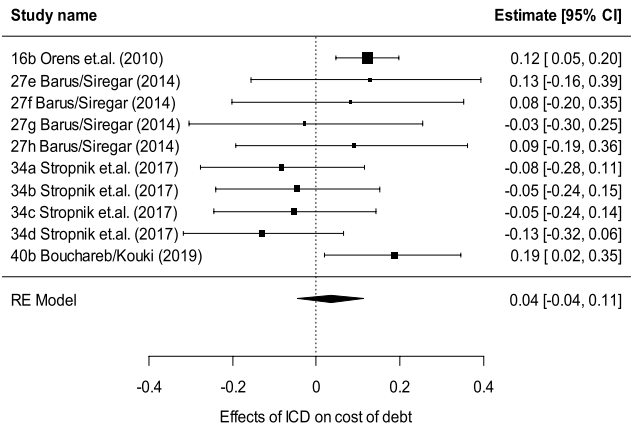

Fig. 6 Results for hypothesis H2b: effects of voluntary ICD on the cost of debt. Random-effects model, Q-test for heterogeneity: (df = 9) = 13.51, $p = 0.141$; absolute heterogeneity $tau^2 = 0.006$, relative heterogeneity $I^2 = 39\%$

4.3 Meta-regression for moderator analysis

We formally tested the impact of moderator variables in our meta-analysis with meta-regressions. A main difference between sub-group analysis and meta-regression is that the estimated average effect of a sub-group is based only on the k effects included in this sub-group without considering other moderators while the estimated average effect in a meta-regression is based on all k effects within the group and additionally controlling for all other moderators included in the meta-regression. In that sense, meta-regression isolates the effect of a moderator variable within a given set of moderators.

To achieve robust estimates requires sufficient sample sizes for all moderators (Schmidt and Hunter 2014). Table 4 provides details about sample sizes per moderator (i.e., number of effects—k). as well as coding of dummy variables. This coding procedure is essential for understanding the results. Given the categorical nature of our moderators we employed dummy coding based on reference values for each dummy variable. Legal origin, for example, uses the "civil law" category as reference value in order to estimate the effect of common-law countries compared to civil-law countries. Additionally, we regressed on the dependent variables without intercept which gave us estimates of the average effects in presence of categorical moderator variables (Viechtbauer 2010). Standard errors are estimated via the Knapp-Hartung method to account for uncertainty of the estimation of tau^2 (Knapp and Hartung 2003).

We performed meta-regressions for all effects (k = 122) to analyse potential impacts of moderators for the total set of studies as well as for all three types of outcomes where we have enough effects, i.e. market value, cost of equity and

Hypothesis H3		no. of studies	total	no. of effects	mean effect	standard	H_0 coeff=0?	95% confidence interval		Heterogeneity	Likelihood ratio test	
Effect of voluntary ICD on			sample size	k	correlation	error	p value	lower limit	upper limit	I^2 [%]	comparing to mean effect	
accounting returns		**11**	**2912**	**44**	**0.162**	**0.024**	**0.000**	**0.115**	**0.208**	**80.78**	**test statistic**	**p-value**
Moderator 1	common law	6	1943	35	0.134	0.027	0.000	0.081	0.186	81.68		
	civil law	5	969	9	0.266	0.037	0.000	0.197	0.332	45.07	6.067	0.014
Moderator 2	IC in sum	2	343	4	0.062	0.039	0.112	-0.015	0.138	0.00	1.886	0.170
	human capital	7	2559	12	0.184	0.047	0.000	0.093	0.271	82.77	0.348	0.555
	relational capital	5	1683	6	0.294	0.068	0.000	0.167	0.411	78.11	5.172	0.023
	structural capital	6	2110	9	0.168	0.050	0.001	0.071	0.262	77.98	0.025	0.876
	other IC	4	742	13	0.106	0.046	0.021	0.016	0.194	74.88	2.327	0.127
Moderator 3	ranked publications	8	2466	38	0.139	0.024	0.000	0.092	0.184	77.84		
	not ranked publications	3	446	6	0.309	0.073	0.000	0.174	0.431	76.73	6.751	0.009

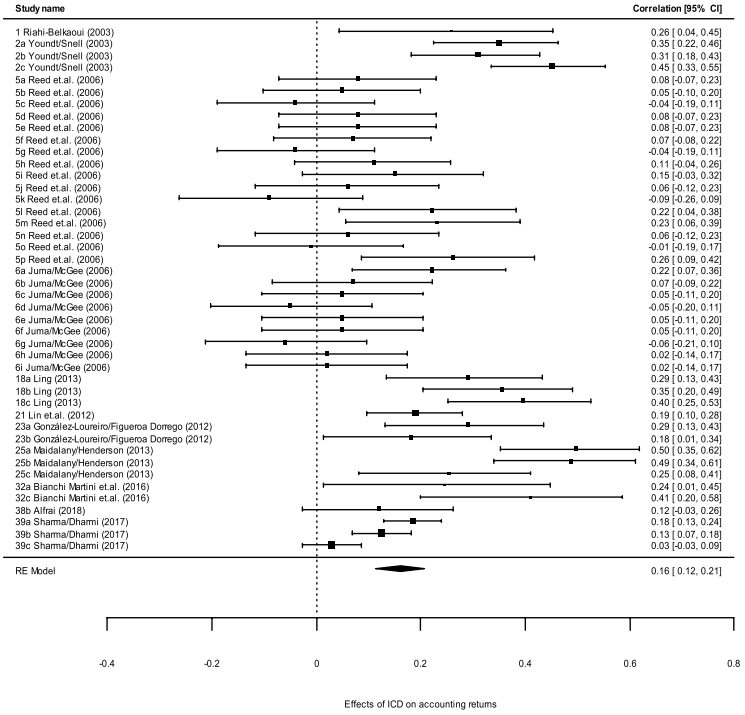

Fig. 7 Results for hypothesis H3: effects of voluntary ICD on accounting returns. Random-effects model, Q-test for heterogeneity: $(df=43)=185.58$, $p<0.01$; absolute heterogeneity $tau^2=0.02$, relative heterogeneity $I^2=81\%$

accounting returns. For the first meta-regression of all effects we multiplied negative effects with (−1) to achieve only effects with proposed positive signs, which then were used in the meta-regression 1. Table 5 depicts the regression results.

Several statistically significant moderator variables are indicated in Table 5. Moderator 1, legal origin, shows an effect for the sub group cost of equity (meta-regression 3). Moderator 2, IC category, indicates for sub-group cost of equity (meta-regression 3) and several statistically significant results especially for sub-group accounting returns (meta-regression 4). Moderator 3, journal rank, shows a small effect for all studies in total (meta-regression 1).

Regarding heterogeneity, measured with I^2, this is the lowest for cost of equity ($I^2=65\%$) which means that the moderators explain a significant share of heterogeneity between studies analysing voluntary ICD impact on cost of equity.

Table 4 Moderator and dummy variables for meta-regression

Moderators		Dummy variables	Value	Meaning	No. of effects k	Total
Moderator 1	Legal origin	Common_law	0	Civil law	54	*113*
			1	Common law	59	
Moderator 2	IC category	IC sum	(If all other category variables are zero)		46	*122*
		Human_cap	1	Human capital	23	
		Relational_cap	1	Relational capital	16	
		Structural_cap	1	Structural capital	19	
		Other_cap	1	Other capital	18	
Moderator 3	Ranking of publication	Journal_rank	0	Not ranked publication	44	*122*
			1	Ranked publication	78	

*9 study effects relate to a diverse set of countries and cannot be assigned to one of the categories

Given that the previous moderators do not reduce heterogeneity for all subsets we can test further moderating variables in an exploratory fashion but it is advised not to include any variables because that increases the risk of capitalizing on chance and reduces statistical power (Schmidt and Hunter 2014). Simulations show that with around k = 150 effects it is not advised to use more than eight moderators in meta-regressions (ibid). With k = 122, as in our case, the number of moderators should be even lower.

We selected additional moderators based on the literature: (1) "publication year" because, following Dumay 2016, the discussion of voluntary ICD followed several stages with increasing awareness, knowledge and refined measurement of voluntary ICD. Hence, newer studies might benefit from accumulated knowledge and increase their measurement procedures and measure clearer effect sizes; (2) "Country" because voluntary ICD research is clustered in certain countries (Cuozzo et al. 2017) and one might propose different effects due to different jurisdictions and differently developed capital markets. Albeit, only two countries have a significant amount of studies and effects, i.e. the USA and Taiwan (see Fig. 2); (3) type of information source of voluntary ICD: Annual reports and other official and audited documents are seen as most useful sources of instruments for stakeholders (Guthrie et al. 2004; Guthrie and Petty 2000; Ienciu 2014). Hence, we divided the dataset in such effects from annual reports and IPO prospectuses compared to other sources. This dummy variable is called "company reports" (comp_reports). Table 6 depicts the coding and descriptive statistics for these moderators 4 to 6. While it would be of interest to see differences in quality and quantity of voluntary ICD as moderators, only two studies (Gerpott et al. 2008; Sieber et al. 2014) discussed the aspect of quality of voluntary ICD. It is therefore not possible to use this as a moderator variable.

Table 7 indicates that publication year has a statistically significant but very small effect for all studies (meta-regression 5) as well as in the sub-group accounting returns (meta-regression 8). This supports the notion that study results over the year gain precision in measuring effects of voluntary ICD. The dummy variable comp_reports exerts a clear positive effect for the sub-group market value (meta-regression 6) which underlines the importance of including IC information into annual reports and IPO prospectuses for capital market participants. The dummy variables for countries show for Taiwan a positive effect over all studies (meta-regression 5) and for the USA a small positive effect in the sub-group accounting returns.

To sum up all meta-regressions, we find the following results for heterogeneity (Table 8). Overall, the absolute heterogeneity (tau^2) is clearly below 0.1 for all sub-groups which is small compared to the mean effect sizes (second column in Table 8). The I^2 metric indicates that most of this variance stems from differences in true effects between studies, and not from sampling variance. The moderator analysis shows that in the sub-group cost of equity the proportion of variance explained by moderators is reduced to 38%. In other sub-groups the moderator analysis does not reduce this proportion of variance. However, several moderators exert statistically significant changes in aggregated effects.

While absolute heterogeneity (tau^2) is between 0.01 and 0.06 and, compared to the combined effect sizes, small, relative heterogeneity (I^2) is mostly in a high range, except for cost of equity with 63% to 68% (Higgins et al. 2021). One candidate for

Table 5 Results of meta-regression for moderators 1 – 3 (estimates are Fisher z-values)

Meta-regression 1: $tau^2 = 0.0264$ $I^2 = 81\%$ RMSE = 0.187		DV = all effects		k = 122 F(df1 = 6, df2 = 116) = 6.6245, *p*-val < .0001 QE(df = 116) = 627.1000, *p*-val < .0001		
Dummy variable	Estimate	Standard error	t value	*p* value	Confidence interval	
					lower bound	upper bound
Common_law	0.034	0.036	0.954	0.342	−0.037	0.105
Human_cap	0.030	0.046	0.643	0.522	−0.062	0.121
Relational_cap	0.107	0.051	2.109	0.037	0.007	0.207*
Structural_cap	0.032	0.049	0.649	0.518	−0.065	0.129
Other_cap	−0.003	0.054	−0.050	0.960	−0.110	0.104
Journal_rank	0.078	0.034	2.316	0.022	0.011	0.144*
Meta-regression 2: $tau^2 = 0.0713$ $I^2 = 91\%$ RMSE = 0.267		DV = Market value		k = 42 F(df1 = 6, df2 = 36) = 1.1018, *p*-val = 0.3803 QE(df = 36) = 575.7060, *p*-val < .0001		
Dummy variable	Estimate	Standard error	t value	*p* value	Confidence interval	
					lower bound	upper bound
Common_law	0.096	0.084	1.137	0.263	−0.075	0.267
Human_cap	−0.169	0.156	−1.086	0.285	−0.485	0.147
Relational_cap	−0.041	0.178	−0.229	0.820	−0.401	0.319
Structural_cap	−0.227	0.210	−1.079	0.288	−0.652	0.199
Other_cap	−0.157	0.153	−1.027	0.311	−0.466	0.153
Journal_rank	0.111	0.077	1.446	0.157	−0.045	0.266.
Meta-regression 3: $tau^2 = 0.0213$ $I^2 = 65\%$ RMSE = 0.153		DV = Cost of Equity		k = 23 F(df1 = 6, df2 = 17) = 4.5216, *p*-val = 0.0065 QE(df = 17) = 51.4441, *p*-val < .0001		
Dummy variable	Estimate	Standard error	t value	*p* value	Confidence interval	
					lower bound	upper bound
Common_law	−0.189	0.077	−2.470	0.024	−0.351	−0.028*
Human_cap	−0.115	0.096	−1.198	0.247	−0.316	0.087
Relational_cap	−0.066	0.096	−0.692	0.498	−0.268	0.136
Structural_cap	−0.235	0.096	−2.462	0.025	−0.437	−0.034*
Other_cap	−0.087	0.169	−0.513	0.615	−0.443	0.270
Journal_rank	−0.114	0.084	−1.355	0.193	−0.292	0.064

Table 5 (continued)

Meta-regression 4: $tau^2 = 0.0176$ $I^2 = 77\%$ RMSE = 0.144		DV = Accounting returns		k = 44 F(df1 = 6, df2 = 38) = 9.7196, p-val < .0001 QE(df = 38) = 156.2637, p-val < .0001		
Dummy variable	Estimate	Standard error	t value	p value	Confidence interval	
					lower bound	upper bound
Common_law	−0.021	0.062	−0.338	0.737	−0.148	0.105
Human_cap	0.266	0.075	3.567	0.001	0.115	0.417***
Relational_cap	0.355	0.076	4.650	< .0001	0.200	0.509***
Structural_cap	0.241	0.074	3.243	0.003	0.090	0.391**
Other_cap	0.195	0.081	2.417	0.021	0.032	0.359*
Journal_rank	−0.068	0.067	−1.009	0.319	−0.204	0.068

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

explaining the remaining heterogeneity is the different metrics used in the studies to measure value relevance. This is apparent for the sub-group market value where studies use a variety of metrics like market capitalization, stock prices, market-to-book ratios or price-earnings ratios. The same holds to a lesser degree for the sub-group accounting returns where profitability ratios as well as net profit or growth of profits are employed. However, the small number of cases per metric does not allow further statistical analyses.

4.4 Analysis of a publication bias

As especially high-quality journals prefer to accept studies with significant results, meta-analytic results may be affected by publication bias (Khlif and Chalmers 2015). To check for the existence of publication bias, we used funnel plots and additional rank and regression tests. An asymmetric funnel plot is one possible indicator for publication bias, as normally the dispersion of the single correlation coefficients around its mean value increases with an increasing standard error

Table 6 Coding of additional moderators 4 to 6

Moderators		Dummy variables		No. of effects	Total
Moderator 4	Publication year	Pubyear	0 = 2013, …,16 = 2019	122	122
Moderator 5	Country of study	USA	1 = study performed in the USA	40	122
		TAIWAN	1 = study performed in Taiwan	11	
		All other countries	0	71	
Moderator 6	Company reports	Comp_reports	0 = others	0	122
			1 = annual reports, IPO prospectus	83	

Table 7 Results of meta-regression for moderators 4 – 6 (estimates are Fisher z-values)

Meta-regression 5: $tau^2 = 0.0287$ $I^2 = 83\%$		DV = all effects		k = 122 F(df1 = 4, df2 = 118) = 19.4798, *p*-val < .0001 QE(df = 118) = 705.9148, *p*-val < .0001		
					95% confidence interval	
Dummy variable	Estimate	Standard error	t value	*p* value	Lower bound	Upper bound
Pubyear	0.009	0.004	2.375	0.019	0.002	0.017*
USA	0.032	0.031	1.017	0.312	−0.030	0.094
TAIWAN	0.177	0.060	2.932	0.004	0.058	0.297**
Comp_reports	0.071	0.042	1.702	0.091	−0.012	0.154
Meta-regression 6: $tau^2 = 0.0532$ $I^2 = 89\%$		DV = Market value		k = 42 F(df1 = 4, df2 = 38) = 4.5380, *p*-val = 0.0043 QE(df = 38) = 534.7094, *p*-val < .0001		
					95% confidence interval	
Dummy variable	Estimate	Standard error	t value	*p* value	Lower bound	Upper bound
Pubyear	−0.002	0.008	−0.264	0.793	−0.018	0.014
USA	−0.095	0.082	−1.147	0.259	−0.261	0.072
TAIWAN	0.193	0.131	1.478	0.148	−0.071	0.458
Comp_reports	0.205	0.084	2.439	0.020	0.035	0.375*
Meta-regression 7: $tau^2 = 0.0191$ $I^2 = 68\%$		DV = Cost of Equity		k = 23 F(df1 = 2, df2 = 21) = 13.7887, *p*-val = 0.0001 QE(df = 21) = 64.2476, *p*-val < .0001		
					95% confidence interval	
Dummy variable	Estimate	Standard error	t value	*p* value	Lower bound	Upper bound
Pubyear	−0.013	0.011	−1.262	0.221	−0.035	0.009

Table 7 (continued)

Meta-regression 7: $tau^2 = 0.0191$ $I^2 = 68\%$		DV = Cost of Equity		k = 23 F(df1 = 2, df2 = 21) = 13.7887, *p*-val = 0.0001 QE(df = 21) = 64.2476, *p*-val < .0001		
					95% confidence interval	
Dummy variable	Estimate	Standard error	t value	*p* value	Lower bound	Upper bound
Comp_reports	−0.058	0.108	−0.537	0.597	−0.283	0.167
(Moderators USA and TAIWAN are redundant)						
Meta-regression 8: $tau^2 = 0.0205$ $I^2 = 81\%$		DV = Accounting returns		k = 44 F(df1 = 4, df2 = 40) = 11.6107, *p*-val < .0001 QE(df = 40) = 184.2209, *p*-val < .0001		
					95% confidence interval	
Dummy variable	Estimate	Standard error	t value	*p* value	Lower bound	Upper bound
Pubyear	0.0207	0.0058	3.5996	0.001	0.009	0.032***
USA	0.0703	0.0332	2.1217	0.040	0.003	0.137*
TAIWAN	0.1286	0.0924	1.3923	0.172	−0.058	0.315
comp_reports	−0.0528	0.0585	−0.903	0.372	−0.171	0.065

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 8 Summary of effects and heterogeneity metrics tau^2 and I^2

Group	Mean effect	95% confidence interval		Without moderators		With moderators 1 to 3		With moderators 4 to 6	
		Lower bound	Upper bound	tau^2	I^2	tau^2	I^2	tau^2	I^2
All effects	0.116	0.085	0.148	0.02	80%	0.26	81%	0.03	83%
H1: market value	0.132	0.053	0.209	0.06	90%	0.07	91%	0.05	89%
H2a: cost of equity	−0.192	−0.254	−0.128	0.01	63%	0.02	65%	0.02	68%
H2b: cost of debt	−0.035	−0.114	0.044	0.01	39%	Subgroup not included in moderator analyses			
H3: accounting returns	0.162	0.115	0.208	0.02	81%	0.02	77%	0.02	81%

(Sutton 2009) and thus creates the form of a reverse funnel. The rank test evaluates correlations between observed effect sizes and corresponding sampling variances (Begg and Mazumdar 1994). A high rank correlation is also an indicator for funnel plot asymmetry and hence publication bias. The regression test evaluates statistical associations between observed effect sizes and predicted effect sizes based on the meta-analysis model (Sterne and Egger 2005).

The funnel plot (Fig. 8) shows individual effects. Many studies seem to have similar standard errors between 0.05 and 0.1 despite different effect sizes while not many studies have large standard errors. The rank correlation test is not significant (Kendalls tau = 0.067, $p = 0.3123$), the same holds for regression test (t = 0.3572, df = 120, $p = 0.7216$). We performed the same analyses for all other groups (see technical appendix) and found no indication for a publication bias based on that (Sterne et al. 2011).

5 Discussion, implications and limitations

5.1 Discussion

The starting point for our study was the lack of consensus concerning the value relevance of voluntary ICD (Dumay and Garanina 2013; Giacosa et al. 2017). Our meta-analysis goes beyond existing qualitative literature reviews because it allows us to quantitatively estimate mean correlations and to consider the impact of moderating variables on effects. Overall, it reveals a significant effect of voluntary ICD on disclosing firms' equity value. Voluntary ICD is value relevant, for capital markets and investors. The following table summarizes our main results (Table 9).

Voluntary ICD obviously reduces information asymmetry on capital markets and is associated with higher market value, lower cost of equity and higher accounting returns. Effects sizes are moderated by the firms' legal origin but in different directions: The stronger effect of voluntary ICD on cost of equity in common law countries might be connected to a reduction of the variation in analysts' and investors' prediction of future cash flows which is connected to a lower risk premium and thus

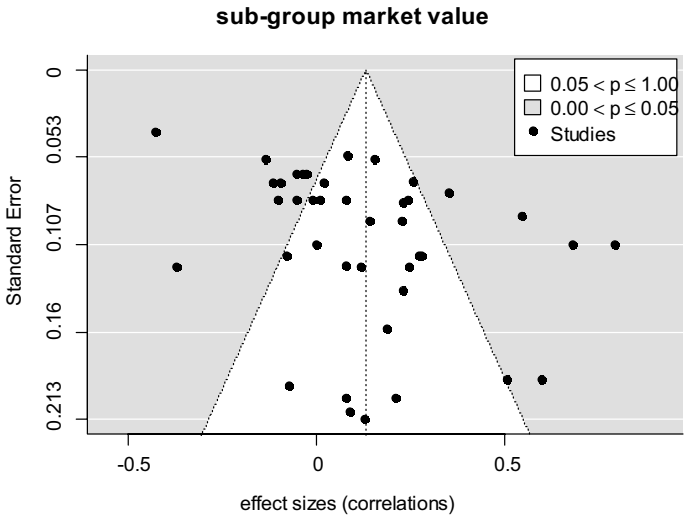

Fig. 8 Funnel plot for effects of voluntary ICD and financial outcomes

Table 9 Results in a nutshell, mean correlations with 95% confidence intervals and number of effects (k)

Effect category	Summary
Value relevance in general	Significant positive mean correlation 0.116 [0.085; 0.148], k = 122 Sub group analysis: no significant effects compared to sample mean
H1: Market value	Significant positive mean correlation 0.132 [0.053; 0.209], k = 42 sub group analysis: stronger for IC sum and not ranked journal publications
H2a: Cost of equity	Significant negative mean correlation −0.192 [−0.254; −0.128], k = 23 sub-group analysis: stronger effect for common-law countries
H2b: Cost of debt	Insignificant negative mean correlation −0.035 [−0.114; 0.044], k = 10
H3: Accounting returns	Significant positive mean correlation 0.162 [0.115; 0.208], k = 44 sub-group analysis: stronger effect for civil-law countries, relational capital and non-ranked publications
Results of meta-regressions	In different effect categories significant effects for moderator 1 'common-law countries', moderator 2 'IC categories', moderator 3 'journal quality', moderator 4 'publication year', moderator 5 'country', and moderator 6 'company reports'

lower costs of capital. The positive effect of voluntary ICD on accounting returns for civil-law countries cannot be explained by reducing information asymmetries because accounting returns are not influenced by investor expectations as with cost of equity. Given that this effect is based in only k = 9 effects it might be a statistical phenomenon of small sample sizes.

The negative association between voluntary disclosure and cost of capital was also identified by the meta-analysis of Souissi and Khlif (2012). However, they did not focus on voluntary ICD but analysed all types of voluntary disclosure.

Compared to our meta-analysis they found a lower mean correlation of r = −0.116 which was stronger in a low disclosure environment (−0.216) than in a high disclosure environment (−0.056). They explain their results that in high-level corporate disclosure environments—which are partly overlapping with common law countries—the variability of disclosure practices across firms is not significant and thus the marginal effects of disclosure practices are lower. Also, investors might access IC information from private sources or have access to more timely information such as press releases or analysts' forecasts and thus have sufficient information to allocate their resources, whereas in civil law countries annual reports remain the most important information source used by analysts and investors.

Contrary to Crook et al. (2011), we find that the mean correlation between human capital and financial effects is lower and not stronger compared to other IC categories. Instead, relational capital disclosure seems to have a stronger impact on the financial performance of the disclosing firms. This is also somehow contrary to the results of Albertini and Berger-Remy (2019) who find a negative association between relational capital and corporate financial performance. Overall, we conclude that the relationships and the interdependencies between the different IC categories are not well understood and give opportunities for future research.

Interestingly, effects of voluntary ICD on cost of equity are stronger for publications in ranked journals whereas effects on market value are stronger for studies published in not ranked journals. This might indicate a specific research focus on financial effects of voluntary ICD on capital markets in high-quality journals.

The meta-regression results support the relevance of several moderators chosen in this meta-analysis: legal origin affects the impact of voluntary ICD, also some categories of voluntary ICD show more or less impact and, as in other meta-analyses, quality of publication outlets matters also (e.g. Derfuss 2016). Additionally, we find evidence for effects of publication year, country and voluntary ICD measurement (annual reports).

The difference in measuring voluntary ICD makes a statistically significant difference for market value. This seems to make sense from a theoretical point of view. Since capital markets face asymmetric information problems, reliable information on voluntary ICD in annual reports and IPO prospectuses reduce information asymmetry and might lead to a more favorable evaluation of firms (Armstrong et al. 2010).

5.2 Implications for future research

Our results indicate potentials for future research. First, we did not find a sufficient number of study effects for all types of financial effects and all moderators to draw reliable conclusions. This is in contrast to Dumay and Cai 2015, for example, who question the need for further studies based on content analysis.

Second, we found no studies that analyse the indirect effects from voluntary ICD mediated by cost of capital or accounting returns on equity value. This means there is an important causal link or "mechanism" (Vanderweele 2009) lacking in

understanding the effects of voluntary ICD. Further studies using mediated regression or structural equation models might further our insights into direct and indirect as well as causal effects of voluntary ICD. To achieve this, studies would need to collect voluntary ICD, cost of capital, accounting returns and market equity value per company studied.

Third, there is a need for further studies of the effects of voluntary ICD for stakeholders other than investors and analysts (Vanini and Rieg 2019). Therefore, Dumay (2016) introduces a broader definition of value and value relevance including monetary, utility, social and sustainable value. Especially, effects of voluntary ICD on the utility, social and sustainable value for other stakeholders such as customers, employees or society have hardly been studied so far. According to stakeholder and legitimacy theory, voluntary ICD may support mutual understanding between a firm's various stakeholders and reduce information asymmetries with positive effects on the disclosing firm's reputation among actual and potential employees or customers (Caputo et al. 2016).

Fourth, the effect of other disclosure channels besides the dominating annual reports such as corporate websites etc. should be analysed in detail, because these information sources probably reveal value relevant and more on-time firm-specific IC information (Cuozzo et al. 2017; Dumay and Cai 2015). Besides, more research is needed concerning the interaction effects of the different IC categories (Albertini and Berger-Remy 2019).

Fifth, while our study overall indicates value relevance of voluntary ICD, it should be kept in mind that additional voluntary ICD is costly and can lead to negative effects like exploiting information of firms by competitors (Giacosa et al. 2017). A deeper understanding of cost and benefits of voluntary ICD and how firms evaluate these would help in understanding disclosure policies of firms.

Sixth, a further avenue for future studies is in analysing combined effects of mandatory and voluntary disclosure. Schiemann et al. (2015) for example showed that mandatory disclosure of intangibles can be in some cases complementary and in others substitutive to voluntary disclosure of IC. Either way it might reduce problems of omitted variable bias in studies and shed new light into the interplay of different accounting information provisions on effects of accounting information.

Seventh, our meta-analysis reveals a considerable heterogeneity of studies. This might stem in part from a lack of a consistent framework for measuring the independent variable of voluntary ICD (Dumay and Cai 2014; Guthrie and Petty 2000). For example, Abeysekera (2006) found at least five different coding frameworks used in studies. Dumay and Cai (2015) concluded that although there seems to be an agreement on the three higher-level IC-categories, "there is no consensus on exactly what the lower-level categories should be." Thus, we follow Souissi and Khlif (2012, p. 59) and recommend "to develop a new disclosure proxy which combines all information's aspects including quality, credibility, timeliness and contents" of voluntary ICD. The same recommendation can be given concerning the measurement of non-financial effects of voluntary ICD such as utility value, social value and sustainable value (for an intense discussion of the three concepts see Dumay 2016).

Eighth, several concerns regarding applied methods of studies are apparent. First, a majority of studies used sample sizes below 100 which risks capitalizing

on chance and leads to larger sampling errors and variations in effect sizes. Second, many studies while collecting longitudinal data did not take advantage of them, i.e. they pooled data instead of analysing time-varying effects or, better yet, applying panel data analysis to identify causal relationships. Third, despite the importance of discussion quantity and quality in measuring voluntary ICD (see Sect. 3.3), only two out of 40 studies discussed this and integrated it in their measurement concept (Gerpott et al. 2008; Sieber et al. 2014). Here lies an opportunity to improve future voluntary ICD studies and to achieve more valid results. Fourth, many papers apply several statistical analyses on the same dataset (see Table 2) without correcting for possible inflation of significance levels. To avoid such family-wise errors (Pituch and Stevens 2016) studies might report only mean effects and confidence intervals or apply Bayesian statistical inference.

5.3 Practical implications

As financial analysts and investors use voluntary ICD information for valuation purposes, it is beneficial for firms to engage in voluntary ICD. Hence, voluntary ICD is neither a management fashion nor a sort of window dressing (Fincham and Roslender 2003) or a wealth-creation myth (Dumay 2016).

In addition, standard setters and policymakers should develop a standardised framework for voluntary ICD "that would address the issues of comparability over time, relevance and reliability of the information disclosed" (Mention 2011) and thus improve the quality and utility of voluntary ICD for shareholders and other investors (Albertini and Berger-Remy 2019; Dumay and Cai 2014). Therefore, it seems necessary to focus not only on improving the quantity of information disclosed. In fact, the different information needs of various relevant stakeholders should be taken into consideration when developing a more structured and yet focused approach for voluntary ICD and defining specific indicators for IC evaluation. A standardised framework with a set of standardised IC indicators would prevent firms from window dressing within their disclosure by avoiding to disclosure unfavourable but value relevant information concerning their IC.

5.4 Limitations

Several limitations of our study are worth to be noted. Although we strictly tried to apply the recommended meta-analysis process, there remains a risk of missing some relevant studies. Our search relied on specific search terms which means that with slightly different terms or search strings other studies might have been came to light. Besides, we have focused our literature research on studies published in English. Thus, there might exist relevant studies published in other languages.

While in reality, firms disclose mandatory and voluntary information on intellectual capital, our study was limited to voluntary ICD. However, one would expect to see the combined effects of mandatory and voluntary ICD also. This would call for another meta-analysis study.

Also, there exist alternative measures for intellectual capital like the value-added intellectual coefficient (VAIC). We found at least 17 such empirical studies. It would be worthwhile to understand the effects of such alternative IC measures in the future.

Despite these limitations, which also call for future studies, we think that our meta-analytic results add important evidence in favour of voluntary ICD given that we found for nearly all categories of effects and nearly all disclosure channels significant effects.

Appendix 1: Overview of studies

Study	Sample/Analysed effect
1. Abdolmohammadi (2005)	Longitudinal analysis of 58 US-firms between 1993 and 1997/financial effects
2. Abeysekera (2011)	Longitudinal analysis of 30 listed firms from Sri Lanka between 1998 and 2003/financial effects
3. Alfraih (2018)	Cross-sectional analysis of 182 firm from Kuwait in 2013 / financial effects
4. Anam et al. (2011)	Comparative-static analysis of 91 Malaysian firms in 2002 and 2006/financial effects
5. Anifowose et al. (2017)	Pooled data of 91 Nigerian firms between 2010 and 2014/financial effects
6. Barus and Siregar (2014)	Cross-sectional analysis of 79 Indonesian firms in 2010/financial effects
7. Bianchi Martini et al. (2016)	Cross-sectional analysis of 73 European firms in 2013/financial effects
8. Bouchareb and Kouki (2019)	Pooled data of 135 firm-years from Tunisia between 2010 and 2014/financial effects
9. Boujelbene and Affes (2013)	Cross-sectional analysis 102 French firms in 2009/financial effects
10. Flöstrand (2006)	Cross-sectional analysis of 250 US firms between 1999 and 2005/financial effects
11. Gamerschlag (2013)	Longitudinal analysis of 369 firm-years from Germany between 2005 and 2008/financial effects
12. Garanina and Dumay (2017)	Pooled data of 154 US firms between 2002 and 2013/financial effects
13. Gerpott et al. (2008)	Cross-sectional analysis of 29 international firms in 2003/financial effects
14. González-Loureiro and Figueroa Dorrego (2012)	Pooled data of 140 firm-years from Spain between 2003 and 2006/financial effects
15. Juma and McGee (2006)	Comparative-static analysis of 161 US firms between 1992 and 2000/financial effects
16. Kristandl and Bontis (2007)	Cross-sectional analysis of 95 firms from Austria, Germany, Sweden and Denmark in 2005/financial effects
17. Labidi and Gajewski (2019)	Pooled data of 72 French firms between 2000 and 2009/financial effects

Study	Sample/Analysed effect
18. Lin et al. (2012)	Cross-sectional analysis of 428 firms from Taiwan in 2006/financial effects
19. Ling (2013)	Cross-sectional analysis of 146 firms from Taiwan/financial and non-financial effects
20. Majdalany and Henderson (2013)	Pooled data of 124 firms from the United Arab Emirates in 2010/2011/financial effects
21. Mangena et al. (2010)	Cross-sectional analysis of 126 UK firms in 2004/2005/financial effects
22. Mangena et al. (2016)	Cross-sectional analysis of 125 UK firms in 2004/financial effects
23. Nielsen et al. (2015)	Cross-sectional analysis of 120 Japanese firms in 2003/financial effects
24. Orens et al. (2010)	Pooled data of 668 European and US firms in 2002/2003/financial effects
25. Ott et al. (2014)	Pooled data of 215 European and US M&A transactions between 2005 and 2008/financial effects
26. Reed et al. (2006)	Comparative-static analysis of 169 US firms in 1999/financial effects
27. Riahi-Belkaoui (2003)	Longitudinal analysis of 81 US firms between 1986 and 1993/financial effects
28. Saenz and Gomez (2008)	Pooled data of 43 Spanish firms between 2001 and 2003/financial effects
29. Sharma and Dharni (2017)	Cross-sectional analysis of 1,200 firm-years from India between 2004 and 2013/financial effects
30. Sieber et al. (2014)	Pooled data of 700 firm-years from Germany between 2002 and 2008/financial effects
31. Stropnik et al. (2017)	Cross-sectional analysis of 103 firms from Slovenia between 2013 and 2016/financial effects
32. Tseng and Goo (2005)	Cross-sectional analysis of 81 firms from Taiwan in 2000 / financial effects
33. Uyar and Kılıç (2012)	Cross-sectional analysis of 129 Turkish firms in 2010/financial effects
34. Uzliawati and Djati (2015)	Pooled data of 31 Indonesian firms between 2008 and 2012/financial effects
35. Vafaei et al. (2011)	Cross-sectional analysis of 220 firms from UK, Australia, Hong Kong and Singapore in 2005/2006/financial effects
36. van der Zahn and Singh (2007)	Cross-sectional analysis of 334 firm from Singapore between 1997 and 2004/financial effects
37.van der Zahn et al. (2007)	Cross-sectional analysis of 334 firm from Singapore between 1997 and 2004/financial effects
38. Wang and Chang (2008)	Cross-sectional analysis of 31 firms from Taiwan in 2004/financial effects
39. Youndt and Snell (2004)	Cross-sectional analysis of 208 US firms in 2000/2001/financial effects
40. Young et al. (2007)	Cross-sectional analysis of 211 firms from Taiwan/financial effects

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11846-023-00630-3.

Funding Open Access funding enabled and organized by Projekt DEAL.

Data availability On request.

Code availability On request.

Declarations

Conflict of interest The authors declares that they have no conflict of interest.

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Those included in the meta-analysis are marked with *

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