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Do Online Financial Reports Actually Improve the Information Environment?

An Empirical Investigation of European Listed Firms

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Digital reporting is a growing phenomenon in the ongoing practice of advanced financial reporting. Over the past years, the dissemination of financial information via the internet has increased and the use of standardized financial reports that are published in HTML format, called online financial reports (OFR), has become an important part of an integrative disclosure strategy. The results of prior qualitative studies already mentioned the perceived benefits of disseminating financial information using advanced financial reporting formats such as IFR and XBRL. However, there is a lack of empirical evidence on the benefits and consequences of using OFR as part of an integrative disclosure strategy. This study addresses this research gap and investigates the impact of OFR on the information environment of European listed firms. Our baseline results support the perceived benefits of the increasing dissemination of OFR in line with signaling theory. However, these findings are subject to endogeneity (self-selection) and are not robust to instrumental variable analysis. Overall, our findings are informative to different stakeholders on the capital markets such as financial report preparers and investors.

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1 Introduction

Digital reporting is a growing phenomenon in the ongoing practice of advanced financial reporting. Over the past years, the dissemination of financial information via the internet has increased and the use of standardized financial reports that are published in hypertext markup language (HTML) format, called online financial reports (OFR), has become an important part of an integrative disclosure strategy. Even in the context of future financial reporting in Europe, listed firms will be required to mandatorily adopt this format due to the European Single Electronic Format (ESEF) regulation (European Commission 2019; EU 2013). According to different internet sources, this human readable format has several benefits such as easy handling (use and editing), it is compatible to all browsers and screen devices, it is search engine friendly, it is interactive in terms of integration of hyperlinks, which potentially reduces search costs, and multimedia content (e.g., photo, audio, video). Compared to PDF, the HTML format is also smaller in memory space.[1] Until today, the use of the internet and of the format HTML is quite common in financial reporting. This technology is supposed to be a modern channel for stakeholder communication (FEE 2015). All over the world, firms have published financial information via the internet. Based on this, financial report preparers have started to publish their complete financial reports on a single web page. In contrast to classic PDF-files or spreadsheets (e.g., excel-files), these OFR own an individual uniform resource locator (URL), a specific page source, and contain special features such as hyperlinks, multimedia, and multi-device-monitoring. According to Chatterjee and Hawkes (2008), around 7% of studied companies in New Zealand already have used OFR in 2004. A more recent study conducted by Loos-Neidhart et al. (2018) shows the importance of this format in the context of financial reporting. They observe

[1] Please find the following internet-based articles to the benefits of HTML:
http://lab.nexxar.com/annual-report-microsite-vs-website/,
https://openjournalsystems.com/digital-publishers-benefit-html/,
https://constructive.co/insight/best-practices-for-online-reports-part-2-d,
http://bcn.boulder.co.us/~neal/pdf-vs-html.html.

the financial reports of the 50 largest firms[2] in Germany (Switzerland) and find that about 53% (59%) of these firms voluntarily disseminate this format in 2017.

In the USA, the use of OFR is more common. After the release of the electronic data gathering, analysis, and retrieval system (EDGAR) by the US securities and exchange commission (SEC) in 1984, the filing procedure in the USA became electronic. In 1997, the SEC further eliminated all paper filings and in 2000 it started to oblige filers to submit their financial reports in HTML format. Two years later, the SEC expanded this regulation: foreign firms listed on a US stock exchange then need to submit their annual filings (so-called 20-F reports) in the new electronic format. Therefore, foreign firms that decide to issue equity securities on a stock exchange in the United States must file an annual 20-F report under to the regulation of the SEC, which implies a mandatory use of the HTML format.

The benefits and costs of the dissemination of OFR have been hardly discussed, even in studies from the last decade. On one hand, a few studies evidence the increasing importance and coverage of firms that use this digital financial reporting format. There are also several other studies that show a higher information quality and usefulness, if HTML is used in the context of financial reporting (we refer to section 3). On the other hand, there are a few studies that show contrary results. According to Hodge and Pronk (2006), professional investors prefer 'traditional' PDF-formatted financial statements over OFR, in contrast to nonprofessional investors who prefer OFR and focus more on the management discussion and analysis (MD&A) when making investment decisions. They also document that investment familiarity has implications of which format and information is preferred over the other. Other studies highlight a non-familiarity of different stakeholders (e.g. accountants, auditors) with this digital financial reporting format (Ghani et al. 2009; Ilias et al. 2015). Regarding the issue of the adoption of a new technology as financial reporting format, several other studies focusing on internet

[2] In accordance with their respective market capitalization.

financial reporting (IFR) and extensible business reporting language (XBRL), which will be another mandated format by ESEF in the EU, already conclude a positive impact of these digital financial reporting formats on the information environment. In the context of IFR, which '[…] refers to the use of the firms' web sites to disseminate information about the financial performance of the corporations' (Poon et al. 2003), a large number of qualitative (Basoglu and Hess 2014; Dolinšek et al. 2014; Ahmed et al. 2018) and quantitative studies[3] (Gajewski and Li 2015; Aerts et al. 2007; Trabelsi et al. 2008) show an increased quality of financial information and consequently an improved information environment and a higher firm value. Even in the context of the (voluntary or mandatory) adoption of XBRL, several quantitative studies conclude a positive relationship between the adoption of the new digital financial reporting format and different information environment measures (Ra and Lee 2018; Geiger et al. 2014; Efendi et al. 2016).

To the best of our knowledge, there is no quantitative research concerning the question of how the information environment in the capital market is influenced by the digital financial reporting format HTML. We identify a corresponding research gap in the literature on digital financial reporting. We therefore analyze the impact of OFR on firms' information environment in both mandatory and voluntary settings. We conduct multivariate statistical analysis using a European sample with the 185 largest European listed firms. We conduct several robustness checks including a Heckman selection model to control for sample selection and instrumental variable regression analysis to examine potential self-selection of firms to disseminate OFR. We show that firms using OFR have higher analyst following and stock liquidity than non-OFR firms. However, these results suffer from endogeneity. Thus, we consider OFR as a reporting channel with signaling potential towards investors but with no measurable impact on the capital market side. This study contributes to the ongoing research concerning digital financial reporting

[3] We define a study as a qualitative one, if it comprises field study (e.g., interviews) or survey methodology in accordance with classification by Oler et al. (2010). We define a study as a quantitative one, if it comprises archival methodology in accordance with classification by Oler et al. (2010).

formats. While prior studies often apply qualitative and experimental research on the topic of HTML, we extend this research by conducting empirical analyses on the consequences of the voluntary and mandatory use OFR in a European setting. Therefore, we link our analysis to existing empirical research in the context of IFR and XBRL. Finally, our findings may have practical implications on different stakeholders on the capital markets such as financial report preparers and investors.

2 Theoretical Background

The theoretical foundation of our research is generally based on agency theory (or principal-agent theory) promoted by Jensen and Meckling (1976). This theory is a frequently applied approach in the field of (internet) financial reporting and, thus, we adopt this approach in the context of our research topic. Principal-agent theory suggests that, if the goals of the principal (in our context usually the shareholder) and the agent (in our context usually the management) are in line, the agent will take decisions that intend to maximize the welfare of the principal. In case of divergent goals and self-interest acting by the agent, a potential information asymmetry would lead to an adverse selection problem. This problem potentially decreases the principal's ability to determine the agent's best interests (e.g., personal earnings maximization, improved reputation). Possible issues that arise from the agent's self-interest maximizing are among others excessive use of perquisites, asset misappropriation, and enhancement of salary. These problems consequently lead to costs for the principal (so-called agency costs) that result from the behavior of the agent. To mitigate agency costs, the principal would implement monitoring processes. Financial reporting is such an instrument and is intended to improve the information asymmetry between agent and principal by a standardized exchange of information. The mandatory adoption of financial reporting regulation such as IFRS in the EU thus could improve the information asymmetry (Horton et al. 2013; Turki et al. 2017).

Beyond to the content of information, also the format of financial reporting potentially could lead to a more effective and efficient exchange of financial information. The freely available financial information published by listed firms often cannot be fully utilized to uninformed investors, since their information processing capacity is limited. Therefore, information processing costs can influence the incorporation of information (Sims 2006). Information technologies could lower such information processing costs (Dong et al. 2016). The more effective and efficient information exchange process consequently leads to lower monitoring costs since the principal can obtain relevant information faster. According to Saleh and Roberts (2017), the use of the internet as reporting medium reduces agency costs. Other technologies such as XBRL lead to similar reductions (Shan et al. 2015; Lai et al. 2015; Makni et al. 2018; Chen et al. 2018a). Therefore, it is questionable whether the use of OFR as a digital financial reporting format will influence the agency costs similarly.

In the context of voluntary financial reporting practices, another relevant theory is signaling theory (Shehata 2013; Verrecchia 1983; Cotter et al. 2011). This theory is assumed to be a subcategory of the agency theory and further describes how agents could lower the information asymmetry to the principals. Based on the theoretical approach, initially promoted by Spence (1973), specific characteristics signal better performance of certain companies compared to other market participants. In the context of financial reporting, voluntary disclosure – above the legal requirements – is a signal for better reporting performance and improved information asymmetry (Shehata 2013). Due to this signal of better information dissemination, voluntary disclosure leads to an improved basis for investments decisions for investors. In line with the above-mentioned agency theory issues, the voluntary adoption of digital financial reporting format signals superior performance of voluntary adopters. Following Saleh and Roberts (2017), the voluntary use of internet financial reporting (IFR) attracts analysts. Even the voluntary adoption of XBRL as a signal for improved financial reporting is a benefit to investment decisions of potential investors (Kim et al. 2019; Premuroso and Bhattacharya 2008).

Following signaling theory, we analyze the voluntary dissemination of HTML as financial reporting format as a signal of advanced financial reporting means and superior firm performance toward investors.

3 Literature Review and Hypotheses Development

The HTML format has become an important issue in the context of financial reporting from a practical and a research perspective. A few qualitative studies about the use and benefits of IFR have been conducted in the 21st century. This research mainly focuses on the improvement of IFR on the quality of financial reporting according to the frameworks of IASB and FASB (IASB 2010; FASB 2010). In these frameworks, the quality of financial information is dependent on the qualitative characteristics of decision usefulness such as relevance, reliability, timeliness, and accessibility.

According to Almilia and Budisusetyo (2017), Al-Htaybat et al. (2011), and Ilias et al. (2014) the accessibility of financial information is perceived to be higher when financial information is disseminated through the internet. Other research articles find a positive relationship of the use of IFR and the timeliness of financial information (Ahmed et al. 2018; Almilia and Budisusetyo 2017; Al-Htaybat et al. 2011). According to the results of experimental studies conducted by Kelton and Pennington (2012) and Dull et al. (2003), non-professional investors from the US agree to a more efficient use of IFR as a financial information medium due to technical features such as hyperlinks and therefore. Furthermore, the reliability and credibility are positively related to IFR, according to Dolinšek et al. (2014) and Almilia and Budisusetyo (2017). Additionally, Ilias et al. (2014) and Ahmed et al. (2018) conclude a higher relevance, when the internet is used as a financial reporting tool. Studies done by Desoky (2010) and by Subramanian and Raja (2010) further support a positive perception on the usefulness of the internet as financial reporting channel. Lastly, all these aspects of improved data quality and increased usefulness lead to a decision-supporting character of IFR (Al-Htaybat et al. 2011; Ilias et al. 2014).

Other qualitative studies rather focus on the digital HTML format specifically. According to Teo et al. (2003), hypertext systems such as HTML result in greater user satisfaction, effectiveness, and efficiency. Even in the context of financial reporting, HTML is likely to improve data quality in terms of better timeliness, dissemination, and usefulness, according to Ghani et al. (2009) and Chatterjee and Hawkes (2008). Complementary, Rowbottom and Lymer (2009), Hodge and Pronk (2006), and Beattie and Pratt (2003) find that HTML is the most preferred format for users compared to PDF and spreadsheets in the Netherlands and UK. Also for Germany, OFR are the most frequently used source for financial information by investors and analysts compared to PDF or paper-based reports (Hoffmann et al. 2019).

Following these reviewed research articles, the use of OFR is perceived to positively impact the quality of reported information in several regions worldwide. Consequently, the preferences for this digital financial reporting format have increased over time. In addition to the qualitative approaches already mentioned, there are several studies analyzing the effect of format specific attributes of IFR (e.g., presentation, usability, format) on the information environment in terms of transparency and information asymmetry, and consequently on firm value. While existing IFR literature mainly supports a positive impact of IFR on transparency (Lai et al. 2010; Hunter and Smith 2009; Bagnoli et al. 2014), information asymmetry (Gajewski and Li 2015; Aerts et al. 2007; Saleh and Roberts 2017; Trabelsi et al. 2008), and firm value (Sadalia et al. 2017; Mendes-Da-Silva et al. 2014; Adityawarman and Khudri 2017) caused by a more accessible, timelier, and less costly way to disseminate financial information, the results based on a format-specific (e.g., presentation, usability, format) view on IFR show mixed results. According to Gajewski and Li (2015), Ahmed et al. (2015), and Garay et al. (2013), the use of the internet as a financial reporting format positively impacts the information environment and firm value. In contrast, results obtained by Keliwon et al. (2018) and Saleh and Roberts (2017) show no significant relationship.

Furthermore, another digital financial reporting format that will also be required by European firms in accordance with the ESEF regulation is XBRL. Like the IFR format-specific research, results on the benefits of voluntarily XBRL adoption are mixed. According to Hao et al. (2014), Lai et al. (2015), Kaya and Pronobis (2016), and Amin et al. (2018), the voluntary adoption of XBRL leads to an improved information asymmetry in terms of lower cost of capital, liquidity measures, and timeliness. In contrast to these findings, Geiger et al. (2014), Cormier et al. (2019), and Hsieh and Bedard (2018) find a negative or no relationship between the voluntary adoption of XBRL and information asymmetry.

Overall, these reviewed articles show mixed results on the impact of the voluntary adoption of new digital formats applied in financial reporting on the information environment, such as format specific IFR and XBRL. Taking into consideration the perceived benefits of the digital financial reporting format HTML, we formulate the following hypothesis:

H1: The voluntary use of OFR improves the information environment in Europe.

In addition to the voluntary adoption of such technologies, we further need to consider the mandatory adoption of digital technologies in the context of financial reporting such as XBRL. In line with the findings of research concerning format specific IFR and voluntary XBRL adoption, the results of the benefits of the mandatory XBRL adoption are mixed. According to quantitative analyses done by Ly (2012), Yoon et al. (2011), Liu and O'Farrell (2013), Peng et al. (2014), as well as Liu et al. (2017), the mandatory adoption of XBRL leads to an improved information environment in terms of better information asymmetry, stock liquidity, and market efficiency measures. In contrast, studies done by Blankespoor et al. (2014), Cong et al. (2014), Yen and Wang (2015), and Liu et al. (2014a) show a negative or no impact of the mandatory XBLR adoption and information environment.

Considering the reviewed literature on HTML and IFR, we suggest a similar impact of mandatory OFR and therefore, we formulate our second hypothesis:

H2: The mandatory use of OFR improves the information environment in Europe.

Taking together the reviewed literature, we expect that the use of OFR, regardless of its voluntary or mandatory nature, positively impacts the information environment. This finally leads to the formulation of our third hypothesis:

H3: The use of OFR improves the information environment in Europe.

4 Empirical Model

a. Data collection and sample

Since the use of OFR has increased over the past years and the new ESEF regulation will affect listed firms in Europe, we focus our research on European listed firms. Europe is one of the most important economic areas comprising the 3rd largest capital market in the world[4]. The European setting also primarily allows us to consider both the voluntary and mandatory use of OFR. Our sample selection process consists of three steps (see Table 1). First, we select listed European firms from the S&P Euro, an index designed to be reflective of the Eurozone market (S&P Indices 2019). We base our analysis on the index constituents list as of June 2018 that encompasses 185 companies representing 12 different countries and six different industry affiliations (see Table 2). The composition of the S&P Euro is provided by the Refinitiv Datastream (formerly Thomson Reuters Datastream) database. We exclude six firms whose ordinary stocks *and* preferred stocks, retirement savings plan, or holding firm are included in the S&P Euro. In these cases, we identify two ISINs for one actual firm and exclude the ISIN of the non-ordinary share.

[4] Of all listed entities firms in the world, the firms comprising the most listed shares are located in North America, followed by Asia and the European Union. Please find the respective numbers online: https://www.statista.com/statistics/710680/global-stock-markets-by-country/.

Third, additional exclusions are caused by missing data for single firms or firm-year observations in Datastream.

Step	Selection criteria	Σ	Unit
1.	EURO STOXX 600	600	Firms
2.	The 185 largest firms according to their market capitalization	./. 415	Firms
3.	Firms with two ISINs (regular share and preferred share or pension plans or holding corporation), where the latter is excluded for the absence of an HTML-report	./. 6	Firms
4.	**Subtotal**	**179**	**Firms**
5.	5-year observation period (2014 through 2018)		
6.	**Subtotal**	**895**	**Firm-year observations**
7.	Reduction caused by missing data availability in Datastream (depending on model)	224-328	Firm-year observations
8.	**Final sample size (depending on model)**	**567-671**	**Firm-year observations**

Table 1. Panel data sample identification

In addition to a cross sectional analysis, we further analyze the impact of OFR over time. We thus analyze the sampled firms and their OFR over 5 years. Therefore, the data collection process includes the financial years 2014 to 2018. Overall, our final sample consists of 895 firm-year observations. We hand-collect the OFR from the firms' website. In most cases, these reports are published within the investor relations (IR) website of the respective firm. We identify an OFR for a specific year according to its publication date. That means, for example, an OFR published in early 2017 comprises the financial information of the financial year 2016.

Another data collection step is the gathering of 20-F reports and XBRL-formatted filings. As already mentioned, European firms that are cross-listed on a US stock exchange are required to file their annual report as a 20-F report. To collect this data, we hand-collect these reports on the SEC EDGAR website.

Panel A: Country distribution

Country		Observations	Percentage	Cumulative
1.	France	250	28.09	28.09
2.	Germany	210	23.60	51.69
3.	Spain	95	10.67	62.36
4.	Italy	90	10.11	72.47
5.	Netherlands	85	9.55	82.02
6.	Finland	50	5.62	87.64
7.	Belgium	35	3.93	91.57
8.	Ireland	35	3.93	95.51
9.	Austria	15	1.69	97.19
10.	Luxembourg	10	1.12	98.31
11.	Portugal	10	1.12	99.44
12.	United Kingdom	5	0.56	100.00
Total		**890**	**100.00**	

Panel B: Industry distribution

Industry		Observations	Percentage	Cumulative
1.	Manufacturing	380	42.94	42.94
2.	Finance, Insurance, Real Estate	170	19.21	62.16
3.	Transportation & Public Utilities	160	18.08	80.24
4.	Services	85	9.60	89.84
5.	Wholesale Trade; Retail Trade	55	6.21	96.05
6.	Mining; Construction	35	3.95	100.00
Total		**885**	**100.00**	

Note: Country classifications are based on the I/B/E/S country code (Refinitiv Datastream item IBCTRY). The one UK-based firm as shown in Panel A is RELX, which is included in the S&P Euro and classified as a UK-based firm by Refinitiv Datastream.
Industry classifications are based on the SIC industry classification.

Table 2. Country and industry distributions in the sample

For this purpose, we use the EDGAR search tool[5] to find the respective sampled firms and identify the respective 20-F reports. The same procedure is conducted for the search of the respective published XBRL-formatted 20-F reports. If a US-listed firm publishes a XBRL file, this file can be found within the EDGAR database. As an example,

[5] To gather the respective data, please find the website of EDGAR search tool: https://www.sec.gov/edgar/searchedgar/companysearch.html.

we illustrate the EDGAR search results of SAP SE in the Appendix, Figure 3.[6] When searching for the 20-F reports as filing type, these reports are listed over the past years (filing date). A document report filing in this database includes the OFR and the XBRL file set. The appended Figure 4 illustrates the document format files (mandatory OFR) at the top and the data files (XBRL-filings) at the bottom of the filing list.[7]

In line with prior findings, we observe an increasing number of OFR publications among our sample of European blue-chip firms. The number of OFR usage among the 185 largest European firms has increased from 24.3% in 2014 to 32.4% in 2018 (see also Figure 1).

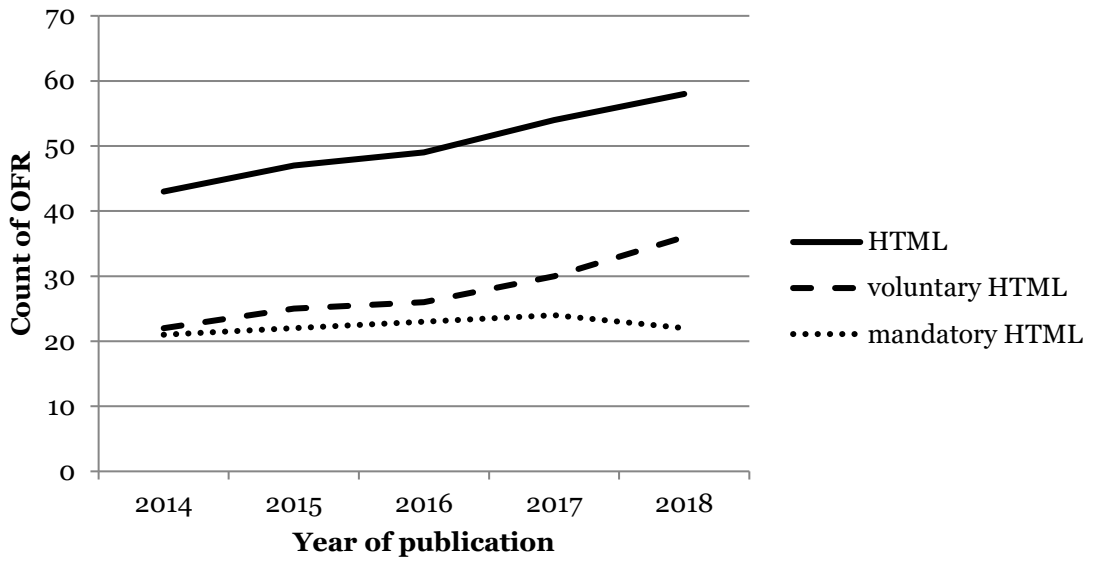

Figure 1. The number of OFR over the observation period

[6] As an example, please find the 20-F reports of SAP SE that are published on the EDGAR database. Online available: https://www.sec.gov/cgi-bin/browse-edgar?action=getcompany&CIK=0001000184&type=20-f&dateb=&owner=exclude&count=40.

[7] The HMTL-reports and the respective XBRL-filings can be found online, please see: https://www.sec.gov/Archives/edgar/data/1000184/000110465919011304/0001104659-19-011304-index.htm.

b. Empirical model and variables definitions

We use an OLS regression model as our baseline model to test *H1*. For this purpose, we state the following equation:

$$\text{InfoEnv} = \beta_0 + \beta_1 * \text{HTML} - \text{voluntary} + \beta_k * \text{Controls} + \text{Fixed Effects} + \varepsilon \quad (1)$$

In that model, the empirical proxies for InfoEnv are metric measures for the information environment. The first is *ANCOV*, i.e., the analyst coverage of the firm. Several studies in the context of financial reporting and new digital financial reporting format use this proxy to explain changes within the information environment. In the context of IFR, this measure is used by Aerts et al. (2007), Bagnoli et al. (2014), and Saleh and Roberts (2017). Even in the context of information environment and XBRL adoption the analyst coverage is used by Liu et al. (2014b). We obtain the information about the analyst coverage from the I/B/E/S database (item number EPS1NET).

Our second proxy for the information environment is the frequently used bid-ask spread. In the context of IFR, this measure is used by Gajewski and Li (2015). Other studies analyzing the impact of XBRL adoption choose this measurement. Bai et al. (2014), Chen et al. (2018b), Geiger et al. (2014), and Yoon et al. (2011) proxy the information environment with the bid-ask spread. For our hypotheses testing, we follow Eleswarapu and Reinganum (1993) and Welker (1995) and define the relative bid-ask spread (*RELSPREAD*) as follows:

$$\text{RELSPREAD} = \frac{\text{ask price} - \text{bid price}}{\left(\frac{\text{ask price} + \text{bid price}}{2}\right)} \quad (2)$$

We obtain the ask- and bid-prices of the respective companies on the date of the EPS announcement date from Datastream.

In our panel data structure, we ensure that the publication date of the relevant OFR is before the respective EPS estimation by the analysts and before the formation of bid- and ask-prices on the EPS announcement date. For example, SAP SE publishes its OFR for financial year (FY) 2017 on February 28th in 2018. Since the respective EPS for

the annual report 2017 of SAP is already announced on January 30th in 2018, we estimate the respective *RELSPREAD* based on the EPS announcement for the next year on January 29th in 2019. This approach is necessary since OFR are usually published after balance sheet date, often several weeks later. Figure 2 illustrates the temporal difference between our variable of interest *HTML(-voluntary/-mandatory)* and the dependent variables *ANCOV* and *RELSPREAD*.

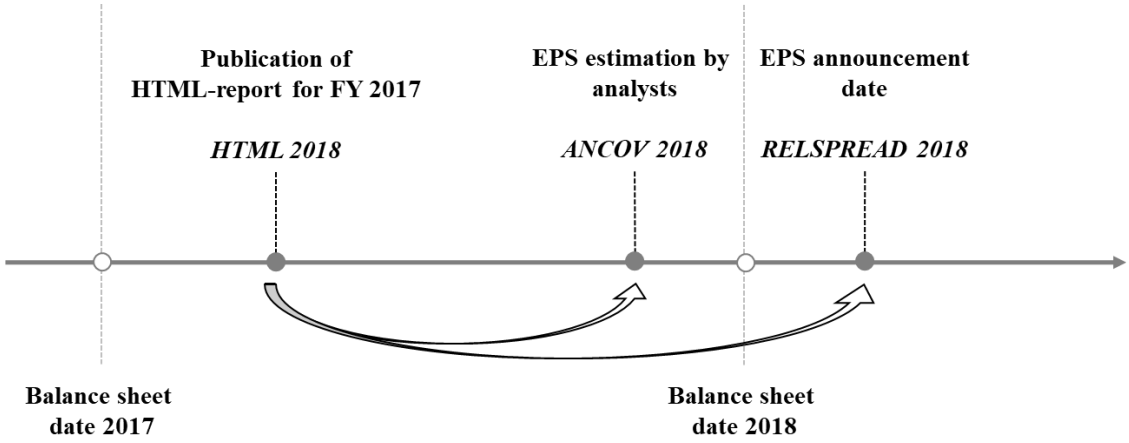

Figure 2. Causality between variables *HTML*, *ANCOV* and *RELSPREAD*

Our independent variable of interest *HTML-voluntary* is a dichotomous variable which is 1, if the firm publishes a voluntary OFR, and 0 otherwise. The selection of an OFR and the respective distinction to other digital financial reporting formats such as PDF is not trivially defined by the literature. Since there is no existing database, which provides information about firms using OFR, this information is hand-collected. We define an OFR as a financial report that is available on the internet as a stand-alone digital medium (not included in within the general company website), but other than the annual financial report in PDF-format or (parts of it) as a spreadsheet (e.g., an Excel file). To specify this criterion, we only focus on digital financial reports that contain a specific page source. Since the HTML format describes a programming language, all OFR need to comprise such a page source. Please find the appended Figure 5, that exemplarily shows the page source of the OFR of the LeGrand SA for FY 2018. Another indication of the appropriate selection of digital financial reports as an OFR is the ending of the

respective URL of the HTML-report webpage. In those cases, the URL contains the ending '.htm' or '.html'. Moreover, in most cases the respective URL of the webpages further include the wording 'report' or a respective abbreviation of 'annual report' such as 'AR'. As an example, we refer to the online report 2018 of Continental AG[8]. Next to the specific digital format, we also consider the content presented in the specific format. For comparability purposes, we only select online reports as an OFR that comprise standardized financial information prepared in accordance with International Financial Reporting Standards (IFRS). The identified online reports further need to comprise at least the balance sheet and the income statement in the HTML format.

To account for the impact on our dependent variables from other possible sources, we further include various control variables. We include firm characteristics including the natural logarithm of market capitalization (in thousand Euros) as a proxy for firm size (*SIZE*), which is often used in relevant archival studies (Aerts et al. 2007; Bagnoli et al. 2014; Geiger et al. 2014; Zamroni and Aryani 2018). We further control for the firm's leverage (*LEVERAGE*), calculated as the total liabilities divided by total assets (Dong et al. 2016; Kim et al. 2012; Mendes-Da-Silva et al. 2014; Sia et al. 2018), and the natural logarithm of the market-to-book ratio (*MTBV*) as the ratio of the firm's total book value and the firm's total market value (Aerts et al. 2007; Bai et al. 2014; Bhattacharya et al. 2017; Blankespoor et al. 2014). To control for profitability differences that might lead to higher analyst attention, we include the actual earnings per share (*EPS*) as control variable (Adityawarman and Khudri 2017; Ahmed et al. 2015; Qi et al. 2018; Wang and Seng 2014) and a binary variable for negative EPS (*LOSS*) as applied in other relevant studies (Kaya and Pronobis 2016; Saleh and Roberts 2017; Trabelsi et al. 2008; Zamroni and Aryani 2018). We further control for liquidity (*CURRENTRATIO*) as proxied by the difference of current assets and current liabilities (Adityawarman and Khudri 2017; Ahmed et al. 2015). Another frequently deployed control variable is a big 4 auditor

[8] Please find the respective URL of the mentioned online report of Continental AG: http://report.conti-online.com/2018/de/index.html.

(*BIG4*) that provides assurance service of the annual statements to the observed firm, i.e. the auditor of the parent company (Ahmed et al. 2015; Ghanem and Ariff 2016; Ra and Lee 2018; Shan et al. 2015). Additionally, similar to Ra and Lee (2018) we include a binary variable for high-tech industry affiliation (*HITECH*; 1 = high-tech industry, 0 = no high-tech industry), since these firms could potentially be more familiar with digital technology and more likely to decide adopting HTML for financial reporting purposes. The measurement of this dichotomous variable is based on Kile and Phillips' (2009) high tech industry definition. Lastly, we analyze a panel data set over several years with different country origins and industry affiliations, and therefore include fixed effects for years, countries, and industries. The year effects allow us to control for potentially underlying trends. The fixed effects for industries and countries allow us to control for unobserved heterogeneity between countries and industries.

$$\text{InfoEnv} = \beta_0 + \beta_1 * \text{HTML} - \text{mandatory} + \beta_k * \text{Controls} + \text{Fixed Effects} + \varepsilon \quad (3)$$

To test hypothesis *H2*, we substitute our variable of interest with *HTML-mandatory*. Please see equation (3). This dichotomous variable equals 1 if the observed firm is listed on a U.S. stock exchange and, thus, must publish a mandatory 20-F report in HTML format, and 0 otherwise. This information is hand-collected from EDGAR. The dependent variable, control variables and fixed effects are the same as in equation (1).

Our third regression equation (4) further combines the voluntary and the mandatory settings. Keeping all other variables as in equations (1) and (3), except for the variable *XBRL*, we now consider the 'full' HTML variable as variable of interest, i.e., all OFR, independent from whether the firms disseminate an OFR on a voluntary basis or following a mandate. We include the additional control variable XBRL, since some of the observed firms already adopted the XBRL technology for their financial report publishing. Given the evidence, that this technology significantly improves the information environment (Li and Nwaeze 2015; Bai et al. 2014; Zamroni and Aryani 2018), we include the dichotomous variable *XBRL* that equals 1 if the financial report is

published in XBRL, and 0 otherwise. We hand-collect this information from EDGAR. Using the following equation (4), we test hypothesis *H3*:

$$\text{InfoEnv} = \beta_0 + \beta_1 * \text{HTML} + \beta_k * \text{Controls} + \text{Fixed Effects} + \varepsilon \quad (4)$$

The independent variable *HTML* is a dichotomous variable that equals 1 if the firm either publishes an OFR voluntarily or following a mandate, and 0 otherwise. Table 3 shows the descriptive statistics of the dependent, explanatory, and instrumental variables used in our model.

Variable		*N*	*M*	*SD*	*Min*	*P25*	*P75*	*Max*
1.	***ANCOV***	880	24.050	6.682	6.000	20.000	29.000	37.000
2.	***RELSPREAD***	881	0.162	0.193	0.010	0.041	0.214	0.990
3.	***HTML***	890	0.282	0.450	0.000	0.000	1.000	1.000
4.	***HTML-voluntary***	890	0.156	0.363	0.000	0.000	0.000	1.000
5.	***HTML-mandatory***	890	0.142	0.349	0.000	0.000	0.000	1.000
6.	***XBRL***	890	0.051	0.219	0.000	0.000	0.000	1.000
7.	***SIZE***	885	10.568	1.493	8.067	9.398	11.489	14.434
8.	***LEVERAGE***	885	45.705	22.068	1.050	30.110	61.460	100.870
9.	***MTBV***	855	0.628	0.685	-0.968	0.113	1.102	2.367
10.	***EPS***	878	3.194	6.458	0.000	0.550	3.460	55.300
11.	***HITECH***	890	0.157	0.364	0.000	0.000	0.000	1.000
12.	***LOSS***	890	0.091	0.288	0.000	0.000	0.000	1.000
13.	***BIG4***	865	0.896	0.305	0.000	1.000	1.000	1.000
14.	***CURRENT-RATIO***	720	1.344	0.593	0.490	0.950	1.550	3.580
15.	***IVCOUNTRY***	890	0.282	0.151	0.000	0.180	0.357	1.000
16.	***IVCOUNTRY-voluntary***	890	0.156	0.121	0.000	0.060	0.214	0.667
17.	***IVCOUNTRY-mandatory***	890	0.128	0.102	0.000	0.080	0.143	0.667

Note: This table summarizes all variables for firms in the sample. The analyzed sample covers 895 firm-year observations in 13 countries during the period from 2014 to 2018. The number of observations, mean, standard deviation, minimum, values at the 25th percentile (i.e., lower quartile), and values at 75th percentile (i.e., upper quartile), and maximum are shown for each variable. Firm-level data are hand-collected (3.-6.), obtained from Refinitiv Datastream (1.-2., 7.-9., 11.-17.), and I/B/E/S (10.) databases. All metric variables are winsorized at their 1st and 99th percentiles.

Table 3. Descriptive statistics of dependent, explanatory, and instrumental variables

5 Results

a. Univariate and correlation analysis

We conduct univariate tests of differences to understand whether the firms using OFR benefit from it by a better information environment. Given the nonparametric nature of panel data, we use Wilcoxon rank-sum tests. The test results show that firms that use an OFR ('OFR-users') are likely to have higher analyst coverage ($p < .001$) and lower bid-ask spreads, i.e., better stock liquidity ($p = .024$), than non-OFR-users. For the subsample of voluntary OFR-users, we filter our data (exclude the mandatory OFR-users), to compare the voluntary OFR-users against the non-OFR-users only; and proceed respectively for the analysis of the subsample of mandatory OFR-users. The same procedure applies to the regression analysis. In addition, we conduct tests of univariate differences on propensity score matched data to ensure that the OFR-users and non-OFR-users are as comparable as possible, based on several observable characteristics. Specifically, we match on *SIZE* (the natural logarithm of market capitalization), *LEVERAGE* (total liabilities divided by total assets), *MTBV* (the natural logarithm of market-to-book ratio), and the respective year of observation. These test results add to the initial picture supporting hypotheses *H1*, *H2* and *H3*, see Table 4.

In addition, nonparametric Spearman (1904) correlations indicate a positive correlation of our variables of interest *HTML* ($p < .001$), *HTML-voluntary* ($p = .109$) as well as *HTML-mandatory* ($p < .001$) with our dependent variable *ANCOV*. We also find negative and significant correlations of *RELSPREAD* and our (dichotomous) variables of interest (see Table 5).

	Variable	Variation[a)] (Between) [Within]	*HTML* = 1[b)] (1)	*HTML* = 0 (2)	Diff.[c)] (1)-(2)	*HTML-voluntary* = 1 (3)	*HTML-voluntary* = 0 (4)	Diff. (3)-(4)
Panel A: Univariate tests of differences - two-sample Wilcoxon rank-sum tests								
1.	*ANCOV*	6.682 (6.362) [2.186]	25.418 n = 251	23.504 n = 629	1.914*** (p < .001) n = 880	23.797 n = 128	23.457 n = 626	0.340 (p = .201) n = 754
2.	*REL-SPREAD*	0.193 (0.168) [0.098]	0.139 n = 249	0.172 n = 632	-0.033** (p = .024) n = 881	0.186 n = 126	0.173 n = 629	0.013 (p = .263) n = 755
Panel B: Univariate tests of differences – propensity score matched sample[d)]								
3.	*ANCOV*		25.418 n = 251	23.638 n = 251	1.780*** (p = .001) n = 502	23.797 n = 128	24.161 n = 128	-0.364 (p = .642) n = 256
4.	*REL-SPREAD*		0.139 n = 249	0.164 n = 249	-0.025* (p = .062) n = 498	0.186 n = 126	0.179 n = 126	0.007 (p = .747) n = 252

	Variable	*HTML-mandatory* = 1 (5)	*HTML-mandatory* = 0 (6)	Diff. (5)-(6)	*HTML-mandatory* = 1 (5)	*HTML-voluntary* = 1 (3)	Diff. (5)-(3)
Panel C: Univariate tests of differences - two-sample Wilcoxon rank-sum tests							
5.	*ANCOV*	26.678 n =115	23.468 n = 626	3.210*** (p < .001) n = 741	27.357 n = 126	23.719 n = 128	3.638*** (p < .001) n = 254
6.	*REL-SPREAD*	0.081 n = 115	0.172 n = 629	-0.091*** (p < .001) n = 744	0.091 n = 126	0.184 n = 126	-0.093*** (p < .001) n = 252
Panel B: Univariate tests of differences – propensity score matched sample[d)]							
7.	*ANCOV*	26.678 n =115	24.567 n = 115	2.111*** (p = .005) n = 230	27.357 n = 126	24.508 n = 126	2.849*** (p = .007) n = 252
8.	*REL-SPREAD*	0.081 n = 115	0.172 n = 115	-0.091*** (p < .001) n = 230	0. 091 n = 126	0.156 n = 126	-0.065*** (p = .004) n = 252

Note: This table summarizes mean differences and univariate test results for both our dependent variables. All metric variables are winsorized at their 1st and 99th percentiles.
a) Reported variation (*total*; *between* firms; and *within* firms, i.e., over time) is the respective standard deviation statistic.
b) Values reported under (1), (2), (3) and (4) are mean statistics.
c) Differences reported are mean differences.
d) The observations are matched on *SIZE* (the log of market capitalization), *LEVERAGE* (total liabilities divided by total assets), *MTBV* (the log of market-to-book ratio), and the respective year of observation.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 4. Univariate tests of differences in analyst coverage and stock liquidity

Variable		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1.	*ANCOV*		-.053	.153***	.054	.204***	.055	.367***	-.035	-.009	-.023	.074**	.013	-.005	-.045	-.034	.097***	-.015
2.	*RELSPREAD*	-.053		-.076**	.073**	-.162***	-.096***	-.190***	-.040	.114***	.129***	.036	-.016	-.055	.079**	.246***	.346***	-.030
3.	*HTML*	.129***	-.075**		.686***	.626***	.368***	.088***	.015	-.023	-.095***	.120***	.001	.040	.074**	.308***	.222***	.162***
4.	*HTML-voluntary*	.031	.053	.686***		-.077**	-.057*	.089***	.050	-.069**	.003	-.075**	-.007	.016	-.052	.243***	.308***	-.015
5.	*HTML-mandatory*	.195***	-.150***	.626***	-.077**		.568***	.080**	-.019	.013	-.151***	.223***	.073**	.051	.145***	.160***	-.015	.235***
6.	*XBRL*	.047	-.066*	.368***	-.057*	.568***		-.028	-.044	.032	-.065*	.140***	-.002	.046	.190***	.119***	.052	.089***
7.	*SIZE*	.330***	-.188***	.084**	.101***	.068**	-.034		.405***	-.589***	-.079**	-.168***	.176***	.002	-.336***	-.047	.008	-.029
8.	*LEVERAGE*	-.050	-.047	.020	.057*	-.016	-.035	.442***		-.234***	-.295***	-.097***	.142***	-.043	-.488***	-.003	-.055	.160***
9.	*MTBV*	-.004	.089***	-.004	-.060*	.023	.035	-.602***	-.261***		.257***	.187***	-.227***	-.067*	.074*	-.021	-.037	.023
10.	*EPS*	-.117***	-.004	.033	.013	.018	-.014	-.034	-.045	.180***		-.097***	-.501***	.044	.053	-.075**	.030	-.284***
11.	*HITECH*	.085**	.059*	.120***	-.075**	.223***	.140***	-.174***	-.079**	.180***	-.101***		-.008	.037	-.016	-.043	-.069**	.010
12.	*LOSS*	.011	-.042	.001	-.007	.073**	-.002	.160***	.162***	-.242***	-.158***	-.008		-.055	-.037	.090***	.071**	.039
13.	*BIG4*	-.007	-.031	.040	.016	.051	.046	.006	-.034	-.084**	.025	.037	-.055		.042	.018	-.051	.053
14.	*CURRENT-RATIO*	-.025	.003	.122***	-.047	.192***	.258***	-.355***	-.430***	.076**	-.071*	.049	-.049	.022		.148***	.152***	-.007
15.	*IVCOUNTRY*	-.085**	.128***	.335***	.233***	.198***	.104***	-.027	.065*	-.019	.264***	-.065*	.094***	-.011	.071*		.764***	.475***
16.	*IVCOUNTRY-voluntary*	.062*	.254***	.235***	.332***	-.027	.036	.014	-.011	-.066*	.003	-.084**	.084**	-.146***	.098***	.701***		.008
17.	*IVCOUNTRY-mandatory*	-.181***	-.016	.200***	-.033	.296***	.080**	-.064*	.100***	.052	.407***	-.012	.036	.118***	-.006	.598***	-.101***	

Note: Parametric Pearson's *r* correlations are reported below the diagonal. Nonparametric Spearman's r_s correlations are reported above the diagonal. Pairwise $N > 666$ for all correlation analyses. All metric variables are winsorized at their 1st and 99th percentiles.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 5. Pearson and Spearman correlations

b. Baseline regression results

To test our hypotheses *H1*, *H2*, and *H3*, we conduct multivariate regression analysis. Table 6 shows the results from the baseline multiple regression models (Models (1a) through (2c)), with *ANCOV* and *RELSPREAD* as the dependent variable, respectively. Overall, the regression results provide support of our hypotheses *H1* through *H3* since the coefficient signs of our variables of interest are as expected, although not always statistically distinguishable from zero with the conventional confidence level threshold of 5 percent. In addition, it can be stated that the explanatory power of all baseline regression models is relatively high (Cohen 1988), given that the R^2 and adjusted R^2 measures exceed a 55 percent value for all models reported in Table 6. Like prior studies, *SIZE* and *MTBV* manifest as beneficial factors to a firm's information environment, while higher *LEVERAGE* and higher absolute earnings per share (*EPS*) are likely to decrease the number of following analysts (*ANCOV*).

In general, we regard the evidence presented in Table 6 as support for our research hypotheses. Specifically, the coefficient estimation for *HTML* ($\beta = 2.205$, $p < .01$) indicates that the use of OFR is likely to positively impact analyst coverage, i.e., the number of analyst's estimates for the firm's EPS one year ahead. Ceteris paribus, OFR-users have approximately two analyst estimates more than non-OFR-users. While no strong and significant statistical relationship is observed for the voluntary use of OFR and *ANCOV* (*HTML-voluntary*: $\beta = 0.622$, $p > .1$), the benefit of OFR usage appears to be strongest for mandatory OFR-users (*HTML-mandatory*: $\beta = 3.814$, $p < .01$). On average, mandatory OFR-users are likely to have about 3.8 analyst estimates more than non-OFR-users.

As for the analysis of bid-ask spreads, our results support the hypothesis of OFR being beneficial to the information environment. With *RELSPREAD* as the dependent variable, our models (2a) through (2c) support our hypotheses, given a coefficient estimate of -0.051 (i.e., negative 5.1 percent; $p < .01$) lower relative bid-ask spread for OFR-users (model (2a)). In model (2b), we observe that there is a particular benefit to

firms that voluntarily use OFR – ceteris paribus, they benefit from approximately 4 percent lower bid-ask spreads.

Dependent Variable	**Analyst coverage (*ANCOV*)**			**Relative Bid-Ask Spread at EPS announcement (*RELSPREAD*)**		
Model	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)
Independent Variable						
HTML	**2.025*****			**-0.051*****		
HTML-voluntary		**0.622**			**-0.047*****	
HTML-mandatory			**3.814*****			**-0.037***
XBRL	1.068			0.003		
ANCOV				0.000	-0.001	-0.001
SIZE	3.045***	2.760***	2.633***	-0.053***	-0.057***	-0.054***
LEVERAGE	-0.084***	-0.058***	-0.077***	0.000	-0.000	0.000
MTBV	1.889***	1.807***	1.565***	-0.024**	-0.027**	-0.023**
EPS	-0.102***	-0.333***	-0.075**	-0.001	0.001	-0.001
HITECH	0.235	-0.937*	0.096	0.046***	0.025	0.049***
LOSS	0.413	-0.825	0.268	-0.027	-0.023	-0.032
BIG4	2.335***	2.360***	2.820***	0.024	0.030*	0.031*
CURRENTRATIO	-0.110	0.239	-0.333	-0.023**	-0.016	-0.027**
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	671	571	578	667	567	575
R^2	.590	.567	.605	.614	.705	.621
Adj. R^2	.569	.542	.582	.593	.687	.598

Note: OLS regressions are run with robust standard errors. All regressions include a constant term.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 6. Results of baseline multiple regression models

To assess the validity of the baseline findings, we conduct various specification tests and find no severe violation, as described in the following. To assess potential multicollinearity, we calculate variance inflation factors (VIF) and find that all VIF are far below a value of 3, indicating no collinearity issue (O'brien 2007). The heteroscedasticity of regression residuals is analyzed with the Breusch Pagan/Cook-Weisberg test as well as a visual assessment of the residuals-vs.-fitted plots. While no issue is detected for our *ANCOV* regressions, both techniques indicate that residuals of *RELSPREAD* models are heteroscedastic and, therefore, we employ robust standard errors in all regressions.

c. Consideration of potential sample selection bias

As described in section 4a, we use a subset of the S&P Euro as our sample, and therefore, the used sample is non-randomly selected. This might raise concerns about the validity of our empirical findings. Our sample considers the largest firms (by market capitalization) of the S&P Euro. This could lead to a sample bias in the selection procedure related to firm size. To address this potential sample selection bias, we employ a Heckman two-step selection model (Heckman 1979). First, we estimate the probit regression model (see equation (5)) for all firms included in the EURO STOXX 600. This index includes all firms included in our sample and more than 420 additional firms. In addition, the choice of the EURO STOXX 600 helps to alleviate the concern of non-random sample selection since it is not based on the Eurozone but includes firms from European developed countries, and thus, additionally includes firms from Denmark, Sweden, Switzerland, UK, for example. The probit regression equation is:

$$P(Incl_{it} = 1) = \Phi(\beta_0 + \beta_1 \, MarketCap_{it} + u_{it}) \tag{5}$$

where the subscript letters indicate the following: *i*, firm; *t*, year. $Incl_{it}$ is a dichotomous variable that indicates whether an observation is included in our sample. The criterion for an inclusion in our sample is whether a firm belongs to the 185 largest public firms in the S&P Euro. Further, market capitalization ($MarketCap_{it}$) in US dollars is included in the model. Based on equation (5), we obtain the inverse Mills ratio (IMR_{it}). The inverse Mills ratio (*IMR*) is used to construct a selection bias control factor. In a second step, we then include the inverse Mills ratio as an additional control variable for each baseline regression model to account for the impact of potential sample selection bias (see Table 7 for Heckman-corrected regression models (3a) through (4c)). The results from these Heckman selection models are in line with our baseline results. Therefore, it is unlikely that our baseline key findings generally suffer from a bias resulting from non-random sampling. Moreover, the explanatory power (both R^2 and adj. R^2) for the *ANCOV* selection models is higher than for the respective baseline

regression models. For the *ANCOV* models, the coefficient estimates of *IMR* are statistically significant, which indicates that controlling for sample selection impact is relevant here. Comparing baseline and selection models for *RELSPREAD*, we find that their explanatory power is essentially equal.

Turning toward the impact of sample selection on our findings, however, we find that sample selection represents a minor limitation to our findings. This is evident from the fact that the coefficient estimates for our variables of interest in our *ANCOV* regression models (3a) through (3c) are slightly smaller than in the respective baseline regressions (models (1a) through (1c)), and from the significant *IMR* coefficients for the *ANCOV* models. For our models with *RELSPREAD* as the dependent variable, we do not observe these potential limitations, because the coefficients of our HTML-regressors are essentially equal for both specifications and the coefficients of *IMR* are not statistically significant.

Dependent Variable	**Analyst coverage (*ANCOV*)**			**Relative Bid-Ask Spread at EPS announcement (*RELSPREAD*)**		
Model	(3a)	(3b)	(3c)	(4a)	(4b)	(4c)
Independent Variable						
HTML	**1.822*****			**-0.051*****		
HTML-voluntary		**0.511**			**-0.047*****	
HTML-mandatory			**3.156*****			**-0.041***
XBRL	0.872			0.003		
ANCOV				0.000	-0.001	-0.001
SIZE	1.783***	1.331***	1.511***	-0.058***	-0.056***	-0.063***
LEVERAGE	-0.056***	-0.021	-0.050***	0.000	-0.000	0.000
MTBV	0.867*	0.674	0.641	-0.028**	-0.026*	-0.032**
EPS	-0.116***	-0.415***	-0.090**	-0.001	0.001	-0.001
HITECH	-0.040	-1.554***	0.026	0.045***	0.026	0.050***
LOSS	0.816	-0.481	0.703	-0.025	-0.023	-0.028
BIG4	2.386***	2.443***	2.804***	0.023	0.029*	0.029*
CURRENTRATIO	-0.167	0.175	-0.300	-0.024**	-0.016	-0.028**
IMR	-8.891***	-12.137***	-8.265***	-0.036	0.018	-0.070
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	666	566	573	664	564	572
R^2	.609	.598	.623	.614	.705	.622
Adj. R^2	.588	.573	.599	.593	.686	.598

Note: OLS regressions are run with robust standard errors. All regressions include a constant term.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 7. Results of multiple regression models with Heckman correction

d. Consideration of potential self-selection

Since firms have considerable discretion, whether to use OFR, all our variables of interest potentially have to be treated as endogenous. This is especially prevalent in the voluntary setting of OFR usage in Europe before the ESEF mandate. This possibility for firms' self-selection stems from management's discretion to publish (or not to publish) an OFR on a voluntary basis in Europe throughout our sample period from 2014 to 2018. This

decision is generally made based on cost-benefit considerations.[9] Therefore, our baseline results may be prone to firms' self-selection mechanism and a resulting selection bias.

Therefore, we use instrumental variable (IV) regression analysis with *HTML* as dependent variable in the first-stage equation, and the respective dependent variable *ANCOV* or *RELSPREAD* in the second-stage equations (excluding *HTML* in the second-stage equation). We proceed analogously for the variables of interest *HTML-voluntary*, and *HTML-mandatory*, respectively. For each variable of interest (*HTML*, *HTML-voluntary*, and *HTML-mandatory*), we derive a particular IV. For example, we derive the instrumental variable *IVCOUNTRY* for the equations including the variable of interest *HTML* and define *IVCOUNTRY* as the percentage of firms that use an OFR in a particular country in a particular year. Next, *IVCOUNTRY* is included as an exogenous regressor into the first-stage equation, which is a regression of *HTML* on *IVCOUNTRY* and the other exogenous covariates used in our baseline models. Such country- or industry-means like our IVs have frequently been used as instruments in prior empirical work (Lev and Sougiannis 1996; Nevo 2000; Hanlon et al. 2003; Cheng et al. 2014). For the second-stage equations, the predicted values of *HTML* (obtained from the first-stage regression), are then used as an independent variable instead of the observed values of *HTML*.

Likewise, we define *IVCOUNTRYvoluntary* (*IVCOUNTRYmandatory*) as the percentage of firms that voluntarily (mandatorily due to SEC filing) use an OFR in a particular country in a particular year. We use these instrumental variables for IV two-stage regressions with inclusion of *HTML-voluntary* and *HTML-mandatory* as variables of interest in the respective second-stage regression. While the threat of self-selection for the voluntary setting appears obvious, the need for IV regression analysis results from

[9] Regarding the benefits of digital financial reporting formats, we refer to section 3. The cost of the dissemination of digital financial reporting formats is analyzed by several studies, therefore we exemplary refer to Ashbaugh et al. 1999 and ESMA 2015.

the cause of *HTML-mandatory*, i.e., the decision to cross-list in the US. This decision is based on cost-benefit analysis and, therefore, is up to managerial discretion.

These two-step models allow us to analyze the potential impact of firms' self-selection bias. Using the Olea-Pflueger robust test for weak instruments (Olea and Pflueger 2013), we are able to reject the null hypothesis of weak instruments with at least 95 percent confidence for all instruments used (not tabulated). It is important to highlight that – except for the second-stage regression results from model (5b) – the obtained coefficient estimates from our IV regressions do not support our baseline results. In fact, the coefficient signs are mostly against the direction suggested by hypotheses *H1* through *H3* and our baseline results (see Table 8 and Table 9). We therefore conclude that our baseline findings are subject to self-selection by firms concerning our variables of interest, *HTML*, *HTML-voluntary* and *HTML-mandatory*. As a result, all our research hypotheses have to be rejected.

For the regression models with the dependent variable *ANCOV*, we acknowledge another potential cause of endogeneity due to reverse causality. Given the present data granularity of firm-year observations, we cannot exclude the possibility that firms set their decision whether or not to use an OFR, given a certain expected future level of or change in the number of following analysts. There is a chance that firms with higher (expected future) *ANCOV* also face higher pressure to present financial information on the internet in form of an OFR. We approach this problem by lagging our independent variables of interest (e.g., *HTML*) by one period, as described in section 4.b. Similarly, we cannot infer from our findings that a first-time use of OFR will inevitably lead to a shift in a firm's analyst coverage. Our empirical research design could not identify such causal effects.

Dependent Variable	***HTML***	***ANCOV***	***HTML-voluntary***	***ANCOV***	***HTML-mandatory***	***ANCOV***
Model	(5a)		(5b)		(5c)	
Independent Variable	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
predicted HTML		**-1.182**				
predicted HTML-voluntary				**3.183***		
predicted HTML-mandatory						**-3.822****
IVCOUNTRY	4.082***					
IVCOUNTRYvoluntary			4.109***			
IVCOUNTRYmandatory					6.265***	
XBRL	omitted†	omitted†				
SIZE	0.357***	3.419***	0.073	3.273***	0.853***	3.716***
LEVERAGE	0.002	-0.074***	0.004	-0.080***	-0.001	-0.080***
MTBV	0.097	2.221***	-0.014	2.483***	0.449***	2.246***
EPS	-0.015	-0.121***	-0.005	-0.367***	-0.021	-0.081**
HITECH	0.623***	1.553***	0.109	0.228	1.106***	2.649***
LOSS	-0.049	0.829	-0.343	-0.500	0.314	0.923
BIG4	0.334	0.107	0.624**	-0.132	0.067	0.066
CURRENTRATIO	0.316***	0.140	0.004	0.539	0.988***	0.577
Industry Fixed Effects	No	No	No	No	No	No
Country Fixed Effects	No	No	No	No	No	No
Year Fixed Effects	No	No	No	No	No	No
N	636	636	571	571	578	578
Pseudo-R² (1st stage) / *R²* (2nd stage)	.189	.287	.125	.252	.369	.261
Adj. *R²*		.277		.240		.249

Note: The first-stage regressions are probit regressions, the second-stage regressions are estimated as OLS regressions with robust standard errors. All regressions include a constant term.
† Coefficient *XBRL* omitted due to collinearity.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 8. Results of instrumental variable regression models for *ANCOV*

Dependent Variable	***HTML***	***REL-SPREAD***	***HTML-voluntary***	***REL-SPREAD***	***HTML-mandatory***	***REL-SPREAD***
Model	(6a)		(6b)		(6c)	
Independent Variable	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
predicted HTML		**0.187*****				
predicted HTML-voluntary				**0.489*****		
predicted HTML-mandatory						**0.066**
IVCOUNTRY	4.310***					
IVCOUNTRYvoluntary			4.107***			
IVCOUNTRYmandatory					6.838***	
XBRL	omitted†	omitted†				
ANCOV	0.041***	0.002	0.020	0.002	0.046***	0.003
SIZE	0.225***	-0.059***	0.009	-0.049***	0.704***	-0.073***
LEVERAGE	0.005	0.000	0.006	0.001	0.003	0.001
MTBV	0.005	-0.012	-0.066	-0.012	0.365**	-0.034**
EPS	-0.012	-0.001	0.000	0.004	-0.022*	-0.001
HITECH	0.580***	0.013	0.104	0.099***	1.011***	-0.001
LOSS	-0.097	-0.046*	-0.321	-0.002	0.204	-0.038
BIG4	0.360	-0.034	0.637**	-0.065***	0.052	-0.021
CURRENTRATIO	0.306**	-0.017	-0.015	0.004	0.984***	-0.030
Industry Fixed Effects	No	No	No	No	No	No
Country Fixed Effects	No	No	No	No	No	No
Year Fixed Effects	No	No	No	No	No	No
N	632	632	567	567	575	575
Pseudo-R² (1st stage) / *R²* (2nd stage)	.205	.086	.129	.142	.388	.078
Adj. *R²*		.071		.126		.062

Note: The first-stage regressions are probit regressions, the second-stage regressions are estimated as OLS regressions with robust standard errors. All regressions include a constant term.
† Coefficient *XBRL* omitted due to collinearity.
*, **, and *** indicates significance at the 10%, 5%, and 1% level, respectively.

Table 9. Results of instrumental variable regression models for *RELSPREAD*

6 Conclusion

According to practitioners' perceptions and the results of several prior qualitative studies, OFR is likely to improve the information environment within the population of EU listed firms, since the format is expected to improve the decision usefulness (e.g., accessibility, timeliness) and processing efficiency. In line with the rich literature on other digital financial reporting technologies such as IFR and XBRL, we hypothesize that

OFR-users are likely to improve the information environment. If so, OFR will represent a relevant factor to enhance firms' analyst coverage and stock liquidity. Since OFR usage is a recent phenomenon firstly adopted by the largest capital market-oriented firms, our sample consists of the largest European firms. This also enables us to study the potential benefits in both voluntary and mandatory settings.

To test our hypotheses of a positive relationship between the use of OFR and the information environment, we use OLS regression models including several control variables and different fixed-effects measures. According to our baseline results, we find that OFR-users are likely to have higher analyst coverage than non-OFR-users. Furthermore, we also show a significant association between the use of this digital financial reporting format and the relative bid-ask spread of the firms' shares. This would mean that the increased dissemination of HTML as a financial reporting format positively impacts the information environment of large European listed firms. We show that our findings are robust to a potential sample selection bias but likely have limited generalizability to smaller firms. The instrumental variable (IV) regression analysis, however, shows that our baseline findings are subject to self-selection by firms to disseminate OFR. In a nutshell, these results lead us to conclude that online financial reports do *not* improve the information environment.

Our study faces limitations. First, we focus on large firms. There are further research opportunities on the impact of the use of OFR for small and medium-sized firms. Second, we only consider European firms. Future research should consider the impact of this digital financial reporting format in other regions of the world. Comparable to the findings of Hunter and Smith (2009), the use of HTML in financial reporting could help firms in emerging markets to attract investors that otherwise would not (or less likely) have considered them for their investment decision. Third, our definition of the dichotomous variables of interest is admittedly of broad nature, since there is neither an accepted standard nor a common definition in the literature of what exactly is an OFR. This is a notable point for future studies since in our research setting

the OFR types are heterogeneous in the subsample of voluntary OFR-users, as exploratory analysis shows. Further conceptual research is required for a more concise understanding and provision of a clear definition. Finally, our baseline findings are robust to several alternative specifications and a Heckman correction for sample selection but our variables of interest likely are of endogenous nature, and thus, all baseline findings are subject to self-selection bias regarding the voluntary use of OFR (in the voluntary setting) or a voluntary cross-listing in the United States forcing the firm to publish an OFR (in the mandatory SEC setting).

This study contributes to the ongoing research concerning digital financial reporting formats. While prior studies often apply qualitative and experimental research on the topic of HTML, we extend this research by conducting empirical analyses on the consequences of the voluntary and mandatory use OFR in a European setting. Therefore, we link our analysis to existing empirical research in the context of IFR and XBRL. Based on existing empirical studies on IFR, which analyses the dissemination of financial information via the internet, we extend this research by analyzing the use of standardized financial reports that are published in HTML format, called online financial reports (OFR). In contrast to existing XBRL, we rather focus on a human-readable than a machine-readable financial reporting format.

Our study delivers implications for listed firms and investors alike. First, listed firms should consider delivering OFR in addition to their legally mandated portfolio of financial reporting formats to distinguish themselves from peers by using OFR as an additional reporting channel – even though OFR does not yield the expected positive market effects. Our descriptive data shows that only a small percentage of European listed firms uses OFR. Thus, it might be perceived as a transparency signal by the capital market. Second, investors may understand that firms with an OFR aim to send such a transparency signal and be able to distinguish transparent from opaque firms. Furthermore, our findings shed light into the current development undertaken by EU regulators in standardizing digital financial reporting channels (ESEF) and its intended

benefits. Given the mandatory adoption of the ESEF for digital financial reporting from 2020 onwards, the empirical results cast some doubt on its legitimacy from an empirical perspective.

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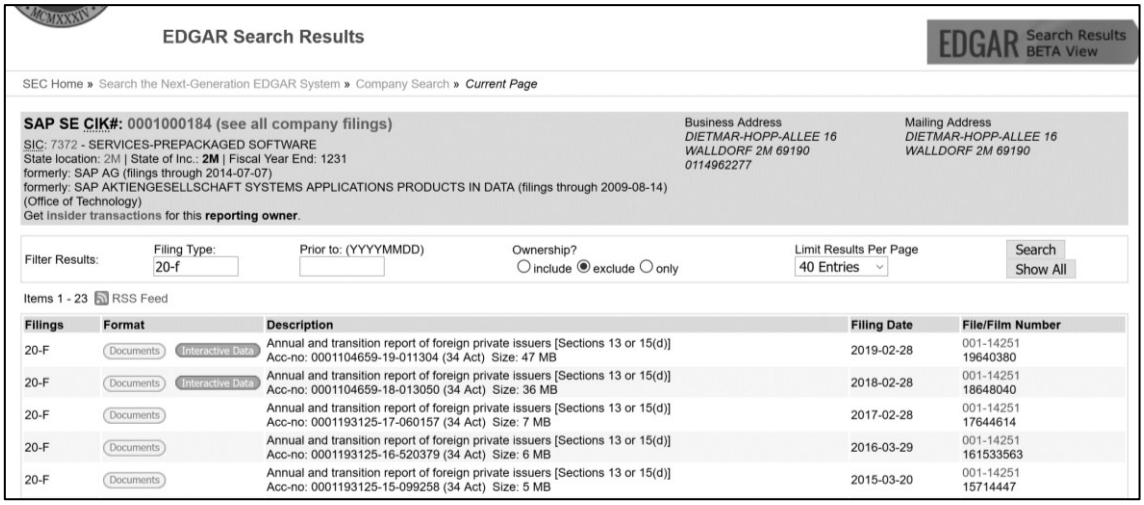
Appendix



EDGAR Search Results

EDGAR Search Results BETA View

SEC Home » Search the Next-Generation EDGAR System » Company Search » *Current Page*

SAP SE CIK#: 0001000184 (see all company filings)

SIC: 7372 - SERVICES-PREPACKAGED SOFTWARE
State location: 2M | State of Inc.: **2M** | Fiscal Year End: 1231
formerly: SAP AG (filings through 2014-07-07)
formerly: SAP AKTIENGESELLSCHAFT SYSTEMS APPLICATIONS PRODUCTS IN DATA (filings through 2009-08-14)
(Office of Technology)
Get insider transactions for this **reporting owner**.

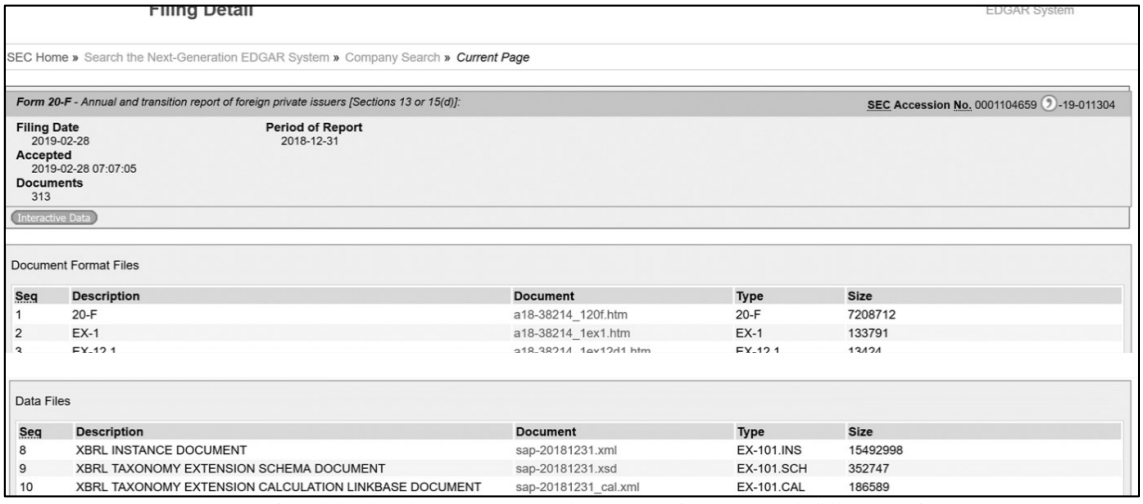
Business Address	Mailing Address
DIETMAR-HOPP-ALLEE 16	*DIETMAR-HOPP-ALLEE 16*
WALLDORF 2M 69190	*WALLDORF 2M 69190*
0114962277	

Filter Results: Filing Type: 20-f | Prior to: (YYYYMMDD) | Ownership? include / exclude / only | Limit Results Per Page: 40 Entries | Search | Show All

Items 1 - 23 RSS Feed

Filings	Format	Description	Filing Date	File/Film Number
20-F	Documents, Interactive Data	Annual and transition report of foreign private issuers [Sections 13 or 15(d)] Acc-no: 0001104659-19-011304 (34 Act) Size: 47 MB	2019-02-28	001-14251 19640380
20-F	Documents, Interactive Data	Annual and transition report of foreign private issuers [Sections 13 or 15(d)] Acc-no: 0001104659-18-013050 (34 Act) Size: 36 MB	2018-02-28	001-14251 18648040
20-F	Documents	Annual and transition report of foreign private issuers [Sections 13 or 15(d)] Acc-no: 0001193125-17-060157 (34 Act) Size: 7 MB	2017-02-28	001-14251 17644614
20-F	Documents	Annual and transition report of foreign private issuers [Sections 13 or 15(d)] Acc-no: 0001193125-16-520379 (34 Act) Size: 6 MB	2016-03-29	001-14251 161533563
20-F	Documents	Annual and transition report of foreign private issuers [Sections 13 or 15(d)] Acc-no: 0001193125-15-099258 (34 Act) Size: 5 MB	2015-03-20	001-14251 15714447

Figure 3: EDGAR search results of SAP SE



Filing Detail — EDGAR System

SEC Home » Search the Next-Generation EDGAR System » Company Search » *Current Page*

Form 20-F *- Annual and transition report of foreign private issuers [Sections 13 or 15(d)]:* **SEC Accession No.** 0001104659-19-011304

Filing Date 2019-02-28
Period of Report 2018-12-31
Accepted 2019-02-28 07:07:05
Documents 313

Interactive Data

Document Format Files

Seq	Description	Document	Type	Size
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2	EX-1	a18-38214_1ex1.htm	EX-1	133791
3	EX-12.1	a18-38214_1ex12d1.htm	EX-12.1	13424

Data Files

Seq	Description	Document	Type	Size
8	XBRL INSTANCE DOCUMENT	sap-20181231.xml	EX-101.INS	15492998
9	XBRL TAXONOMY EXTENSION SCHEMA DOCUMENT	sap-20181231.xsd	EX-101.SCH	352747
10	XBRL TAXONOMY EXTENSION CALCULATION LINKBASE DOCUMENT	sap-20181231_cal.xml	EX-101.CAL	186589

Figure 4: Overview of published HTML- and XBRL-formatted filings of SAP SE

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            right: 0;
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            padding: 0;
        }
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Figure 5: Page source LeGrand SA HTML-report 2018

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HHL Leipzig Graduate School of Management
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