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Graph Usage in Annual Reports,

Evidence from Norwegian Listed Companies

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Abstract:

As investors and other users of annual reports often focus their attention on graphs, it is important that they portray accurate and reliable information. However, previous studies show that graphs often distort information and mislead users. This study analyses graph usage in annual reports from the 52 most traded Norwegian companies. The findings suggest that Norwegian companies commonly use graphs, and that the graph distortions, presentational enhancement and measurement distortion, are present. No evidence of selectivity was found. This study recommends development of guidelines for graphical disclosure, and advises preparers and users of annual reports to be aware of misleading graphs.

Keywords: Graph Usage, Graph Distortion, Annual Reports, Norwegian Listed Companies

1. INTRODUCTION

Over the last decades, the annual report has shifted from a financially statutory document to a design and marketing oriented document (Beattie, Dhanani & Jones, 2008; Lee, 1994). Companies now commonly use images, colors and charts in their annual reports to communicate information. Between 80 and 90 percent of companies in the western world include graphs in their annual reports (e.g. Beattie & Jones, 1992; 1997; 2001; Ianniello, 2009). The length of the annual report has increased significantly, mainly due to an increasing narrative part. A study of large UK listed companies found that the mean number of pages has increased from 26 pages in 1965 to 75 in 2004 (Beattie et al., 2008). More recently, in 2010, annual reports from FTSE100 companies averaged 175 pages (ACCA, 2012). Despite the increasing size of the narrative part, with frequent use of graphs, information included in the narrative part of the annual report is not subject to the same strict regulations and accounting standards as the financial[1] part. Auditors of annual reports in Norwegian companies are required to examine both the narrative and the financial sections, but the guidelines for the narrative section are brief, with no specific regulations for graphical presentation (Finanstilsynet, 2015, pp. 10-11). Notwithstanding, companies commonly use graphs to communicate information. Graphs, when used accurately, have several benefits: they have the ability to focus and attract the readers' attention, facilitate understanding, highlight patterns and trends, help memory recall and break down language barriers (Courtis, 1997). However, as graphs are usually not subject to regulation and accounting standards, they also have the potential to mislead the reader and manipulate the perception of the information portrayed, as several studies have shown (e.g. Beattie & Jones, 1997; 1999; 2000a; 2000b; Courtis, 1997; Ianniello, 2009). Annual reports are one of the primary sources of information for investors, and are often used when assessing whether to buy, keep or sell stocks in a company (Penrose, 2008). Investors use a limited amount of time reading annual reports, and often rely only on

[1] The financial part is here defined as the financial statements with accompanying notes.

information portrayed in graphs when making a decision (Zweig, 2000). Due to the increasing size of annual reports, the high usage of graphs and investors' tendency to focus on them, accurate graph use becomes very important.

The purpose of this paper is to analyze the nature, extent and possible misleading distortions of graph usage in Norwegian listed companies. This paper contributes to the existing literature by documenting graphical reporting practices and presenting evidence of graphical distortions in Norwegian listed companies. The use of graphs in annual reports has, to the best of our knowledge, not been studied in Norway yet. This paper also contributes to an extension of the literature on graphical disclosure in annual reports.

This paper is divided into six sections. Following this introduction, section 2 summarizes the principles for proper graph construction and describes the main graphical distortions. Section 3 summarizes prior empirical research, and section 4 outlines the research questions, the methodology, the sample and descriptive data. The results are presented and discussed in section 5. Finally, section 6 presents the main conclusions of the study and suggestions for future research.

2. NORMATIVE LITERATURE

A graph[2] can be described as a visual display of quantitative information. Several different types of graphs exist, such as column, bar, line and pie, where some are more suitable than others to communicate certain type of data. Despite the variety in graph types, graphs are generally used with two different motives, to analyze data and to communicate information. Annual reports typically use graphs to communicate information (Beattie & Jones, 2008). This section describes existing normative literature on proper graph construction and graphical distortions.

[2] Oxford dictionary defines a graph as: "a diagram showing the relation between variable quantities, typically of two variables, each measured along one of a pair of axes at right angles."

2.1 Principles for Proper Graph Construction

Although graph design is not an exact science, and allows for great creativity and choice, there is extensive literature suggesting characteristics of accurately constructed graphs and principles for proper graph construction. These characteristics and principles can be summarized as an effort to provide to graph viewers the exact same information as the underlying numerical values. Two works from the 1980s by Edward R. Tufte (1983) and Stephen M. Kosslyn (1989) are seen especially important for accurate graph construction. Tufte examines in detail how to achieve graphic excellence and integrity, and describes graphical excellence as well-designed presentations of interesting data. Furthermore, he highlights the importance of the interplay between aesthetics and information density. Kosslyn examines how to reveal design flaws in graphs and suggests certain acceptability principles for graph construction. Summarizing the conclusions from Kosslyn (1989) and Tufte (1983), the following six principles are essential for proper graph construction:

1. The representation of numbers in a graph should be directly proportional to the numerical quantities portrayed (Tufte, 2001, p. 77). Hereunder, avoiding the use of non-zero axis and broken axis (Steinbart, 1989).
2. Graphs should use clear, detailed, and thorough labeling to avoid graphical distortion and ambiguity (Tufte, 2001, p. 77). The use of labels includes a meaningful title, an alpha label on each axis, and numeric labels to indicate values of each scale (Beattie & Jones, 2008).
3. Visual effects, colors, weights of line, the size of a bar/column and the background should be used to emphasize the message, not distract from it (Kosslyn, 1989).
4. The number of dimensions used to depict change should not exceed the number of dimensions in the data (Tufte, 2001, p. 77). Thus, three-dimensional graphs should not be used to portray changes in a single variable (Arunachalam, Pei & Steinbart, 2002).
5. Graph construction should follow cultural norms. Thus, in Western countries, time should increase from left to right or bottom to top (Kosslyn, 1989).

6. Pie/doughnut graphs should contain up to five sections, presented in clockwise descending order (Courtis, 1997).

When properly constructed, graphs are useful to summarize information and highlight trends (Fulkerson, Pitman & Frownfelter-Lohrke, 1999). Following the principles for proper graph construction is essential to avoid graphic distortions, which can manipulate the information portrayed and mislead the reader.

2.2 Graph Distortion

Beattie et al. (2008) classify graphical distortions into three categories: selectivity, measurement distortion and presentational enhancement. *Selectivity* involves whether or not to use graphs and what variables to graph. This distortion occurs when the decision to include a graph and the choice of variables graphed is influenced by company performance (Beattie & Jones, 2000a). *Measurement distortion* refers to the construction of the graph and occurs when the representation of the numbers on the graph is not proportional to the underlying numbers. Thus, measurement distortion arises when the first principle for proper graph construction is violated. One example of measurement distortion is the use of a non-zero vertical axis. Graphs with non-zero vertical axis exaggerate the trend, and can therefore give a false impression of the underlying data. The graph discrepancy index (GDI)[3] can be used to identify and quantify the level of measurement distortion used in graphs. The GDI originates from Tufte's (2001, p. 57) lie factor, and was developed by Taylor and Anderson (1986). Mather, Mather and Ramsay (2005) criticize the GDI for being discontinuous[4] and inconsistent, and presented the relative graph discrepancy index (RGDI)[5] as an alternative measure. The RGDI measures the height of the last column as it is graphed relative to the

[3] $GDI = \frac{a}{b} - 1$, where a = percentage change depicted in graph, and b = percentage change in data.

[4] When the denominator, b=0, it is not possible to calculate the GDI. If the first and the last data points are the same, but the height of the columns are not the same, the graph contain measurement distortion but it is not possible to calculate the GDI.

[5] $RGDI = \frac{g_2 - g_3}{g_3}$ Where: g_1=height of the fist column, g_2=height of the last column, $g_3 = \frac{g_1}{d_1} \times d_2$ = the correct height of the last column, d_1= value of the fist data point, and d_2= value of the last data point.

height at which it should have been graphed. For graphs with no distortions, both the GDI and the RGDI takes a zero index value. As for the GDI, positive values represent exaggeration and negative values represent understatement of the underlying data. For the RGDI, positive values represent exaggeration of an increasing trend and understatement of a decreasing trend, and negative values represent understatement of an increasing trend and exaggeration of a decreasing trend (Mather et al., 2005). Finally, *presentational enhancement* involves the choice of construction and design features for a graph and occurs when one or more of the graphical components enhances or degrades the information portrayed (Beattie & Jones, 2008). This distortion can arise from, among other, the use of visual effects, three-dimensional elements, or the lack of title. For example, the color red, which is perceived to be the most dominant color, can be used to emphasize a trend in an otherwise black and white graphic, attracting the attention to the red trend line (Courtis, 2004).

3. PREVIOUS EMIPIRICAL RESEARCH

Since 1989, a number of studies have examined graph use in annual reports in several countries. Penrose (2008) provides an extensive review on this subject, and concludes that there is widespread disregard for accurate and non-misleading graphical guidelines, across all countries studied. Studies on individual countries have been undertaken in the UK (Beattie & Jones, 1992; 2000a; Beattie et al., 2008), the US (Dilla & Janvrin, 2010; Steinbart, 1989), Australia (Beattie & Jones, 1999; Mather, Ramsay & Serry, 1996), France (Chekkar & Martinez, 2011), Hong Kong (Courtis, 1997), Italy (Ianniello, 2009), and Portugal (Wozniak & Ferreira 2011; Bastardo, 2015). International comparative studies cover the UK and the US (Beattie & Jones, 1997), Australia, France, Germany, the Netherlands, the UK and the UK (Beattie & Jones, 2000b; 2001), and US and non-US companies (Frownfelter-Lohrke & Fulkerson, 2001). The key findings from these studies are summarized below[6].

[6] Please see appendix 1 for more details on the 15 studies presented.

Overall, earlier studies find consistently high and increasing use of graphs in annual reports during the last decades. Steinbart (1989) found that in 1986, 79 percent of US companies use graphs in their annual reports. Beattie and Jones (2001) found consistently high graph usage in Australia, France, Germany, the Netherlands, the UK and the US, ranging from 82 percent in the UK to 92 percent in Australia. In 2004, Beattie et al. (2008) found that graph use in the UK is almost universal, 99 percent of the companies in their sample included graphs in their annual report. Regarding content, financial variables are more likely to be displayed in graphs than non-financial variables (Chekkar & Martinez, 2011; Frownfelter-Lohrke & Fulkerson, 2001). The most commonly graphed financial variables differ slightly from study to study and between countries. However, four variables - sales, earnings, earnings per share (EPS) and dividends per share (DPS) - are identified among the most frequently graphed financial variables across several studies and countries.

A key element in earlier studies has been the relationship between graphs and company performance[7]. Steinbart (1989) and Beattie and Jones (1992) represent two early studies in the US and the UK, which both found evidence of selectivity. In a sample of 319 companies, Steinbart (1989) found that 74 percent of companies that experienced an increase in net income included graphs of sales, income, or dividends, while only 53 percent of the companies who experienced a decrease in net income included graphs of those variables in their annual reports[8]. A few years later, Beattie and Jones (1992) investigated 240 annual reports in the UK and found that 73 percent of the companies with an increase in EPS included graphs of turnover, profit, EPS or DPS, while only 41 percent of the companies with a decrease in EPS did so. Beattie and Jones (1992) concluded that there is a highly significant association between the incidence of graph use and a favorable recent performance. These findings have later been supported in a number of studies (e.g. Beattie & Jones, 1999; 2000b;

[7] Various performance indicators have been used across different studies, including directional change in EPS, net income, and specific key financial variables identified.
[8] Significant at 1% level.

Beattie et al., 2008; Dilla & Janvrin, 2010). There are, however, examples of studies on French, Italian and Portuguese companies, which have not found significant evidence of selectivity distortion (Ianniello, 2009; Chekkar & Martinez, 2011; Bastardo, 2015). This could entail differences between countries, or differences in how selectivity was measured in the studies.

Several studies have investigated the incidence and degree of measurement distortion in different countries. Steinbart (1989) found a mean GDI value of 11 percent in the US, and that almost 26 percent of the graphs distorted the data by more than 10 percent. Beattie and Jones (1992) found that, in the UK, 30 percent of key financial variable (KFV) graphs show material discrepancies[9]. Furthermore, Beattie and Jones (1992) found a mean GDI value of 10.7 percent across the whole sample[10], this value increases to 34.3 percent when based only on material distortions. These findings have later been supported in other studies, and overall, previous studies indicate a high prevalence of measurement distortion (e.g. Beattie & Jones, 1999; 2000b; Frownfelter-Lohrke & Fulkerson, 2001; Ianniello, 2009).

Violation of graph construction principles, referred to as presentational enhancement, has been identified and documented by across studies. Beattie and Jones (1997) found in their study that UK and US companies frequently use a range of presentational devices to enhance information portrayed, including the use of non-scaled axes, no gridlines and three-dimensional elements. These findings have been supported in other studies (Beattie & Jones, 1999; Beattie et al., 2008; Courtis, 1997; Frownfelter-Lohrke and Fulkerson, 2001). In summary, previous research indicates that presentational enhancement is commonly present in graphs, mainly to show the underlying data more favorable than is warranted.

Based on the high frequency of graphical distortions found in previous studies, there is a clear need to develop formal guidelines for graphical disclosure. Formal graphical guidelines

[9] Based on a five percent materiality level.
[10] Defined as all key financial variables graphs.

would give preparers of annual reports increased knowledge about the subject and could, to some extent, prevent graphical distortions. Prior literature is focused on a limited number of countries, and, to the best of our knowledge, evidence from graph usage in annual reports of Norwegian companies has not yet been studied. Thus, this paper contributes to the literature by adding a country to the stream of literature about graph usage in annual reports and examines if graphical distortions in Norwegian companies occur more or less frequently than what is reported in previous research on other countries. In addition, this paper provides recommendations for accurate graph construction and use, thus contributing to better information regarding graph use in financial reporting.

4. RESEARCH DESIGN

The purpose of this research is to analyze graphical disclosure practices in annual reports from Norwegian listed companies and examine whether financial information is presented accurately through graphs. This section outlines the specific research questions to be answered. The first four research questions concern the nature and extent of graph use:

RQ1: *Where in the annual reports are graphs displayed?*

RQ2: *What kinds of information variables are communicated through graphs?*

RQ3: *What types of graphs are used?*

RQ4: *Which colors are used in graphs? Is there an association between graph color and logo color?*

The next three research questions are focused on key financial variables (KFV) and concern graph distortions, hereunder selectivity, measurement distortion and presentational enhancement:

RQ5: *Is there a relationship between the inclusion of KFV graphs and company performance?*

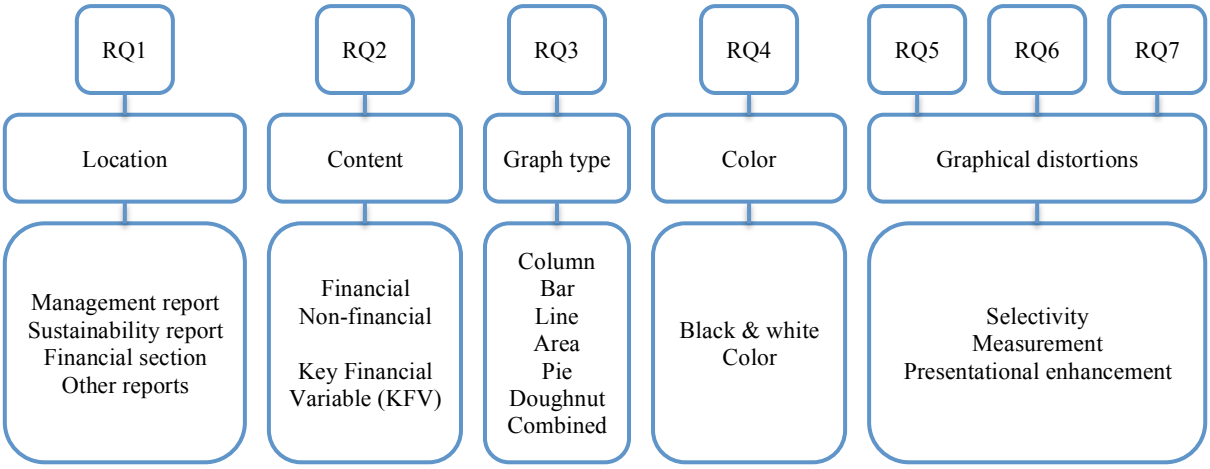
RQ6: *Is the graphical distance portrayed in KFV graph proportional to the underlying numbers?*

RQ7: *Are KFV graphs constructed according to recommended principles?*

4.1 Methodology

A data collection database[11] was designed in excel, where data about graph usage[12], company performance and graph construction were collected. The data collection sheet was pilot-tested on 12 companies, and subsequently revised[13], to ensure completeness. RQ1 to RQ4 was answered based on univariate analysis of the data about graph usage and construction. To answer RQ5, several chi-square tests of independence were conducted. For RQ6, the GDI and RGDI were calculated and evaluated. Figure 1 summarizes the research design according to the research questions and relevant variables.

Figure 1: Research Design



4.2 Sample and Data

This research uses criterion sampling, where the sample is determined according to frequency of trading. Oslo Stock Exchange Benchmark Index (OSEBX) consists of the most traded shares on the Oslo Stock Exchange and was therefore used as the sampling criterion. The index is semiannually revised, and consisted of 53 shares at the end of 2014, but one of the companies on OSEBX is listed with two share classes. This gives a final sample of 52

[11] The database is composed by 55 sheets and a total of approximately 61,000 cells.
[12] Number of graphs, pages in annual report, type of graphs (column, bar, pie, line, area, doughnut or mix), location of graph, type of information graphed (share information, financial, human resources, industry, sustainability or share information), and color used in graphs.
[13] Based on the data collected for the 12 companies, the RQs were checked against the data to see if any additional information should be added. Based on the revision, more specific information for color use was added, as well as more variables in terms of variables graphed.

companies[14]. The sample is based on the most traded companies because of their high importance to both investors and to the Norwegian stock market. The 52 companies analyzed represents 70 percent of the total volume of trade in 2014 (Oslo Børs, 2015)[15]. Data is collected from companies' annual reports for the fiscal year 2014, which were downloaded from the companies' websites. The 2014 annual reports are used since it is the most recent data available, and the reports are still relevant and currently used by investors and other parties. The average number of pages of the annual reports is 120, with the maximum and minimum number of pages being 250 and 47. The average size of the companies, measured as total assets and revenue, is €11,760 millions and €3,439 millions. DNB is the largest company in terms of total assets, with a total asset value of €312,357 millions, and STATOIL is the largest company in terms of revenue, which totaled €71,542 millions in 2014.

The majority of companies examined, 43 out of 52 (82.7%), use graphs in their annual reports. Hence, nine out of 52 (17.3%) companies do not include graphs. These findings suggest that graph use in annual reports is very common in Norway, and the level is in line with previous studies (Beattie & Jones, 2008). A total number of 656 graphs are identified, which gives an average number of 12.6 graphs per annual report. This figure rises to 15.3 when based only on the companies using graphs. There is high variability in the number of graphs used among companies. Based only on graph using companies, the number of graphs varies from one to 53. Two companies, PROSAFE and SUBSEA7, display only one graph, while one company, NORSK HYDRO, displays a total of 53 graphs. Analyzing across industries, companies within the basic materials industry, followed by the consumer goods industry, display the highest average number of graphs, with 34.5 and 17.7 graphs per annual report[16]. Table 1 summarizes the descriptive statistics for the level of graphical disclosure.

[14] Please see appendix 2 for a complete list of the companies.
[15] In terms of number of companies, there were 185 companies listed on Oslo Stock Exchange at the end of 2014, hence the sample analyzed represents 28 percent of the total number of companies (Oslo Børs, 2014, p. 3).
[16] For more details on graph use according to industry please see appendix 3.

Table 1 – Descriptive statistics for the level of graphical disclosure

Companies	
Total sample	52
Number of companies using graphs	43
Percentage of companies using graphs	82.7%
Annual reports	
Total number of graphs	656
Average number of graphs	
based on all companies (n=52)	12.6
based only on companies using graphs (n=43)	15.3
Minimum number of graphs, based only on companies using graphs (n=43)	1
Maximum number of graphs	53

Significant correlations exist between the number of graphs and the number of pages in the annual report (p-value=0.00 and R^2=0.48) and between the number of graphs in the annual report and total asset value of the company (p-value=0.01 and R^2=0.13). Hence, the number of graphs disclosed increases with the number of pages in the annual report and the assets value of the company. There is, however, no significant correlation between the number of graphs and the number of shares (p-value=0.13 and R^2=0.04), nor between the number of graphs and the volume of trade (p-value=0.69 and R^2=0.00)[17].

5. RESULTS

5.1 The Nature and Extent of Graph Usage

Graphical Disclosure Location (RQ1)

The annual report consists of a financial section with financial statements and accompanying notes and a narrative section. The narrative section normally includes a management report and occasionally a sustainability report and other reports. The great majority (98.2%) of graphs appear in the management report. Here, the four most frequently used sections for graph use are: the key figures section (23.5%), the board of directors' report (14%), the shareholder information section (11.6%) and the company overview section (9.1%). Seventy-two point one percent of all companies include graphs in the key figures section, and 9.3 percent of all companies only include graphs in this section. This section is usually within the

[17] For more details on correlations between the number of graphs, the number of pages, asset value, revenue, market value, number of shares and volume of trade, please see appendix 4.

first ten pages of the report, and is used to highlight information and give an impression and overview of the company and last year's results.

Topics Graphed (RQ2)

The total number of financial and non-financial graphs is 341 (52%) and 315 (48%), respectively. The information graphed can be further divided into six broad categories, namely accounting information, capital markets, industry information, human resources, sustainability and customer information. Table 2 shows descriptive statistics about topics graphed. Accounting and capital market variables are the most commonly graphed variables. Thirty-nine (90.7%) companies include graphs that display accounting information, corresponding to 42.2 percent of all graphs. Thirty (69.8%) companies use graphs that display capital market information, including share price, share volume and total stock return. The reason why a large percentage of companies choose to graph accounting and capital market variables might be because these variables are of importance and interest to shareholders. With regards to non-financial variables, information concerning human resources is most commonly graphed in terms of number of companies. Thirty-nine point five percent of companies include at least one graph displaying human resources (e.g. number of employees, employees gender and age). However, industry information is most commonly graphed in terms of number of graphs. Twelve point five percent of all graphs display industry information, compared to 8.1 percent that display human resources variables.

Table 2 – Information variables communicated through graphs

Variable	*Number of companies (n=43)*		*Number of graphs (n=656)*	
Financial variables	**40**	**93.0%**	**341**	**52.0%**
Accounting information	39	90.7%	277	42.2%
Capital markets	30	69.8%	64	9.8%
Non-financial variables	**35**	**81.4%**	**315**	**48.0%**
Human resources	17	39.5%	53	8.1%
Industry information	14	32.6%	82	12.5%
Sustainability	9	20.9%	46	7.0%
Customers	5	11.6%	21	3.2%
*Other**	27	62.8%	113	17.2%

**Includes, among others, harvest volume, credit rating, number of passengers, oil reserves by regions and number of stores.*

Following Beattie and Jones (1992), key financial variables (KFV) graphs are defined as the four most frequently graphed financial variables. This resulted in the following KFVs: Revenue, EBITDA, EBIT and net income. Eighty-one point four percent of all companies graph at least one KFV, and the total number of KFV graphs accounts for 46.3 percent of all financial graphs. The most commonly graphed KFV is revenue, graphed by 76.6 percent of companies, followed by EBITDA, which is graphed by 27.9 percent of companies. Net income and EBIT are graphed by 23.3 and 25.6 percent of companies, and account for 7.6 and 5.6 percent of all financial graphs, respectively. All four KFV are variables that are present in the income statement and that are related to company performance. Companies often choose to present them graphically in order to repeat and highlight this information. Table 3 summarizes the use of KFV graphs.

Table 3 – Key Financial Variables Graphs

Variable	*Number of companies (n=43)*		*Number of graphs (n=341)*	
At least one key financial variable	35	81.4%	158	46.3%
Specific key financial graphs				
Revenue	33	76.7%	95	27.9%
EBITDA	12	27.9%	18	5.3%
EBIT	11	25.6%	19	5.6%
Net income	10	23.3%	26	7.6%

Earnings, sales, EPS and DPS have been defined as KFV in previous studies (Beattie & Jones, 1997; 1999; 2000b). While earnings (net income) and sales (revenues) graphs are frequently found in the sample of Norwegian companies, EPS and DPS receive less graphical attention. Only nine (2.6%) out of 341 financial graphs display EPS and 10 (2.9%) financial graphs display DPS, even though the majority (71.2%) of the companies paid dividends in 2014. When looking at the number of companies graphing these financial variables, EPS and DPS graphs are more present. Twenty point nine percent of companies using graphs include at least one graph displaying EPS, and 18.6 percent include at least one graph displaying DPS. A low number of EPS and DPS graphs included in each company's annual report

explains the difference between the low percentage of EPS and DPS graphs and the higher percentage of companies displaying these graphs[18].

Graph Type Used (RQ3)

The 43 graph-using companies use seven different types of graphs: column, bar, line, area, pie, doughnut and combined. Seventeen (39.5%) companies use four or more types of graphs in their annual report. Details regarding graph types used are shown in table 4. Column graph is the most frequently used graph type, used by 95.3 percent of companies, and accounts for 52.7 percent of all graphs. This is consistent with previous research (e.g. Beattie & Jones, 1999; Chekkar & Martinez, 2011; Bastardo, 2015). Line and doughnut graphs are also commonly used graph types. Sixty-five point one percent of companies using graphs include at least one line graph, and 53.5 percent include at least one doughnut graph. Forty-three out of 565 (6.6%) graphs are termed combined graphs, where all are a mix of column and line.

Table 4 – Graph type overview

Type of graph	*Number of companies (n=43)*		*Number of graphs (n=565)*	
Column	41	95.3%	346	52.7 %
Line	28	65.1%	61	9.3 %
Doughnut	23	53.5%	124	18.9 %
Combined (Line + Column)	18	41.9%	43	6.6 %
Bar	10	23.3%	23	3.5 %
Pie	8	18.6%	48	7.3 %
Area	7	16.3%	11	1.7 %
Total	43	-	656	100 %

Color Use in Graphs (RQ4)

All companies use color[19] in at least one of their graphs. The level of non-colored graphs is minimal. Four companies include a total of nine non-colored graphs, corresponding to only 1.4 percent of all graphs. Blue is the most frequently used color, found in 55.8 percent of all graphs, and used by 83.7 percent of companies. The majority of graphs contain more than one color, 49.7 percent of all graphs include two colors and 14 percent include three colors[20].

[18] All of the companies graphing EPS and DPS only include one or two EPS or DPS graphs.
[19] Color is here defined as all colors except black and white; non-color is defined as black and white.
[20] For a more detailed overview of color usage please see appendix 5.

Studies have shown that color improves communication: color facilitates quicker information acquisition and allows information to be extracted more accurately from the graphical presentations (Hoadley, 1990). The high use of color indicates more effective communication, compared to the use of non-colored graphs. There exist a relationship between the graph color and logo color, 67.4 percent of companies use a color theme based on the company's' logo color(s) in their graphs. This practice is likely common due to design, marketing and brand image considerations.

5.2 Graph Distortions

The three distortions introduced in part 2.2, *Selectivity, Measurement Distortion* and *Presentational Enhancement,* are analyzed in the following sections. For all three distortions, the sample consists of the key financial variable (KFV) graphs. The KFV graphs are used as sample because they are the most graphically displayed financial variables in the sample, they are closely related to company performance and relevant variables for investors. The four KFVs are all displayed in the income statement and are audited variables.

Selectivity in the Use of Graphs (RQ5)

Consistent with earlier research (Beattie & Jones, 1992; 1999; 2000a; 2000b; Marther et al, 1996) selectivity[21] is investigated by testing the association between KFV graphs and company performance. Two alternative performance proxies were used, EPS[22] and the specific KFV graphed. Favorable and unfavorable financial performance was measured as the directional change in the performance indicator from 2013 to 2014. Increases in the performance indicator were classified as favorable performance, and decreases in the performance indicator were classified as unfavorable performance. Selectivity was tested both cumulative and individually, as the association between the presence or absence of at least

[21]For the analysis on selectivity, one company, REC SOLAR, was excluded from the sample. REC SOLAR was established in mid 2013, and does only provide financial statements for the period 2013-2014 as a whole. Thus, the final sample is 51 companies.

[22] EPS is widely used as a benchmark performance indicator (Beattie & Jones; 2000a)

one KFV graph and company performance (directional change in EPS), and as the association between the presence or absence of each individual KFV graph and company performance (directional change in the specific KFV).

For three of the individual variables - revenue, EBITDA and net income -, there is a higher incidence of companies with favorable, rather than unfavorable, performance who display these variables graphically. Sixty-five point nine percent of companies with favorable performance include at least one graph displaying revenue, while 60 percent of companies with unfavorable performance do so. However, for the individual variable EBIT and the cumulative testing of any KFV, the situation is reverse. There is a higher incidence of companies with unfavorable, rather than favorable, performance who display EBIT or at least one of the KFV graphically. Seventy-three point one percent of companies with unfavorable performance include at least one KFV graphically, while 64 percent of companies with favorable performance do so[23]. This suggests that companies' decision to use graphs is not associated with company performance. To further investigate the association between KFV graphs and company performance a series of chi-square tests of independence were undertaken. The results are shown in table 5. According to the results, no significant association is found, neither between the inclusion of at least one KFV graph and company performance, nor between the inclusion of individual KFV graphs and company performance (p-values > 0.05). Consequently, there is no evidence of selectivity distortion. This finding contrasts with most of earlier studies, which found evidence of selectivity distortion (e.g. Beattie & Jones, 1992; 1999; 2000b; Beattie et al, 2008; Dilla & Janvrin, 2010; Bastardo, 2015). Thus, compared to earlier studies, there is a great improvement in graph usage with regards to selectivity.

[23] For more details on the inclusion of graphs and the specific variables (any KFV, revenue, EBITDA, EBIT and net income), please see appendix 6.

Table 5 – Association between KFV graph and company performance

Any KFV	Increase in EPS	Decrease in EPS	Total	
Present graphs	16	19	35	X^2=0.49
Do not present graphs	9	7	16	Critical value=3.84
Total	25	26	51	P-value=0.48

REVENUE	Increase in revenue	Decrease in revenue	Total	
Present graphs	27	6	33	X^2=0.12
Do not present graphs	14	4	18	Critical value=3.84
Total	41	10	51	P-value=0.73

EBITDA	Increase in EBIDTA	Decrease in EBITDA	Total	
Present graphs	9	3	12	X^2=0.30
Do not present graphs	26	13	39	Critical value=3.84
Total	35	16	51	P-value=0.59

EBIT	Increase in EBIT	Decrease in EBIT	Total	
Present graphs	6	5	11	X^2=0.63
Do not present graphs	27	13	40	Critical value=3.84
Total	33	18	51	P-value=0.43

NET INCOME	Increase in net income	Decrease in net income	Total	
Present graphs	7	3	10	X^2=1.45
Do not present graphs	20	21	41	Critical value=3.84
Total	27	24	51	P-value=0.23

Measurement Distortion (RQ6)

Following previous literature (Beattie & Jones, 1992; 1997; 1999; Marther et al, 1996; Steinbart, 1989) measurement distortion is calculated using the graph discrepancy index (GDI). The GDI is the traditional measure for measurement distortion, commonly used in previous studies, and thereby allows for comparisons. In addition, Mather et al. (2005) alternative measure, the relative graph discrepancy index (RGDI), is used to support a potential new measure for measurement distortion, and to compare the results from the GDI[24]. A materiality level[25] of 10 percent is used for the GDI, based on the conclusions of the experimental study of Beattie and Jones (2002). Based on Mather et al. (2005) conclusions[26]

[24] Two examples of GDI and RGDI calculations are shown in appendix 7 and appendix 8.
[25] The majority of previous studies have used a materiality level of 5% to define material distorted graphs (e.g. Beattie & Jones, 1992; 1999; Mather et al., 1996). According to Tufte (2001, p. 57), a GDI in excess of 5% indicates substantial distortion. However, there is little empirical evidence regarding what level of distortion triggers a change in the readers' perception. An experimental study of Beattie and Jones (2002) investigated this, and found that the majority of users would not notice a 5% level of measurement distortion. Their study concludes that measurement distortion in excess of 10% can distort the readers' perception.
[26] Mather et al. (2005) conclude that the slope coefficient from a regression analysis between the GDI and RGDI is approximately 0.5, hence, the equivalent RGDI value for a 10% GDI value is 5%.

the equivalent materiality level for the RGDI is five percent. The sample in this analysis is based on the four KFV graphs (revenue, EBITDA, EBIT and net income)[27].

The incidence of materially distorted graphs is shown in table 6. According to the GDI, material distortions are present in 20 (19.4%) of the graphs analyzed, out of which 12 exaggerate and eight understate the trend of the underlying data[28]. Using the RGDI, material distortions are present in 17 (16.5%) of the graphs analyzed, where 11 exaggerate and six understate the trend. Three of the graphs considered materially distorted according to the GDI are not considered materially distorted according to the RGDI. The difference of three graphs between the two proxies is due to the sensitivity of the GDI when the change in data is small (less than five percent between the percentage change in the graph and the percentage change in the underlying numbers)[29]. None of the graphs were considered materially distorted by the RGDI, and not by the GDI, which supports the use of the RGDI as an additional measure for measurement distortion. The use of two different measures, both supporting the same result, also increases the validity of the result. The rest of the analyses on measurement distortion are based on the 17 graphs that are considered materially distorted by the RGDI.

Table 6 - Incidence of material distorted graphs

The Graph Discrepancy Index (GDI)	Number	Percentage
Material exaggeration: GDI ≥ 10%	12	11.7%
Material understatement: GDI ≤ -10%	8	7.8%
No material distortion: -10% < GDI < 10%	83	80.6%

The Relative Graph Discrepancy Index (RGDI)	Number	Percentage
Material exaggeration: Increasing trend + RGD ≥ 5%	8	7.8%
Material exaggeration: Decreasing trend + RGD ≤ -5%	3	2.9%
SUM	**11**	**10.7%**
Material understatement: Decreasing trend + RGD ≥ 5%	0	0%
Material understatement: Increasing trend + RGD ≤ -5%	6	5.8%
SUM	**6**	**5.8%**
No material distortion: -5% < RGD < 5%	86	83.5%

[27] For this analysis only column and bar graphs were considered. Out of the total of 112 column/bar graphs that were identified, nine were excluded because they did not present at least one of the required values (scale or absolute value). This gave a final sample of 103 graphs.
[28] When applying a 5% level of materiality, distortions are present in 26 (25.2%) graphs, out of which 15 exaggerate the trend of the underlying data, while 11 understate it.
[29] Appendix 9 provides one example where the GDI overestimates the distortion.

Materially distorted graphs are present in 10[30] (23.3%) out of 43 companies, ranging from one to three materially distorted graphs per company. Table 7 shows the nature of measurement distortions. Among the 17 graphs that are materially distorted, eight (47.1%) are favorable and nine (52.9%) are unfavorable to the company[31]. Two underlying reasons for material discrepancies are found. Material discrepancies are attributable to either; the graphical distance portrayed not being proportional to the underlying numbers or the use of a non-zero axis. Out of the 17[32] materially distorted graphs, nine[33] show the graphic distance non-proportionally to the underlying values and eight use a non-zero axis.

Table 7 - Nature of measurement distortions

	GDI	RGDI
Exaggerate favorable trend	9	8
Understate unfavorable trend	2	0
Sum favorable distortions	11	8

	GDI	RGDI
Exaggerate unfavorable trend	3	3
Understate favorable trend	6	6
Sum unfavorable distortions	9	9

In summary, there is evidence of measurement distortion, 16.5% of the graphs analyzed are materially distorted. Ten (23.3%) out of the 43 companies analyzed include KFV graphs with material measurement distortions in their annual report. However, the distortion is more often unfavorable than favorable to the company, suggesting that there is no intention to mislead, and that measurement distortion may result from companies' lack of knowledge on the subject.

Presentational Enhancement (RQ7)

Presentational enhancement is closely tied with the principles for proper graph construction (discussed in part 2.1), and occurs when these principles are violated. For this analysis, all KFV graphs were considered, which gave a final sample of 158 graphs from 35 companies[34].

[30] When using the RGDI as a proxy for measurement distortion. Using the GDI as a proxy for measurement distortion, distorted graphs are present in 11 (25.6%) out of 43 companies, ranging from one to four materially distorted graphs per company.
[31] Using the GDI as a proxy for measurement distortion, from the 20 graphs that were materially distorted, 11 (55%) are favorable and nine (45%) are unfavorable to the company.
[32] Under the GDI, the equivalent number is 20 graphs.
[33] Under the GDI, the equivalent number is 12 graphs.
[34] The sample was divided into three groups according to graph type, the first one contains all KFV graphs (n=158), the second contains only column, bar, area, line and combined graphs (n=116), and the third contains only pie and doughnut graphs (n=42).

Overall, there are 219[35] violations[36], corresponding to an average of 1.4 violations per graph. This suggests that presentational enhancement is highly present in Norwegian companies. One violation among all graph types related to labeling is the use of graph title, 12 (7.6%) out of 158 graphs do not include an effective graph title. A relevant and useful title is important to help the reader focus attention on specific matters and relationships, and the omission of an effective title may mislead and confuse the reader (Courtis, 1997). Only three (1.9%) out of 158 graphs exhibit obtrusive visual effects, two (1.3%) graphs exhibit obtrusive background, and two (1.3%) graphs use three-dimensional effects.

A common violation among column, bar, area, line and combined graphs is the absence of gridlines. In the sample analyzed, 59 (50.9%) out of 116 graphs do not use gridlines, which can make it more difficult for the users to identify data values. In addition, 65 (56%) out of 116 graphs use color to highlight the most recent year's performance, either by using a darker or a different color in the last year. By highlighting the most recent year's performance, the message in the graph may be distracting. Twenty-six (22.4%) of all KFV graphs do not include a financial variable axis, and 11 (9.5%) combine two different scales and baselines. Both violations can easily cause misunderstandings for the reader. Graphs with multiple scales are often complex and difficult to understand. All graphs in the sample follow the recommended time orientation, from left to right or bottom to top.

For clarity, pie/doughnut graphs should include up to five sections, presented in a descending order. There are few violations related to the maximum sections that should be included in a pie/doughnut graph; only two (4.8%) pie/doughnut graphs do so. However, 21 pie/doughnut graphs do not present the sections in a descending order, accounting for 50 percent of all pie /doughnut graphs analyzed.

[35] For a detailed overview on violations of proper graph construction principles, please see appendix 10.
[36] For examples of these violations, please see appendix 11.

Although presentational enhancement is highly present in graphs in Norwegian annual reports, the severity of the violations varies. Severe violations, such as the use of multiple scales and baselines and the absence of a financial variable axis are more likely to affect the perception by the viewer than less severe violations, such as the absence of gridlines. All graphs follow the recommended time orientation, from left to right or bottom to top. Violations of this principle are often intended by the graph designer, and can be seen as an attempt to mislead. Violations related to labeling or highlighting of a specific year however, can be seen as violations where there is not necessarily intention to mislead. There is generally a higher incidence of what can be called non-intentional violations, compared to intentional violations. This suggests that, as with measurement distortion, presentational enhancement may occur due to a lack of knowledge by graph designers.

6. CONCLUSION

This paper examined the nature, extent and possible distortions of graph use in Norway, based on a sample of the 52 most traded companies listed on Oslo Stock Exchange. This study contributes to an extension of literature on graphical disclosure in annual reports by documenting graphical reporting practices and presenting evidence of graphical distortions for the first time in Norway. In addition, this study provides recommendations for accurate graph construction and use for both preparers and users of graphs, contributing to better information regarding graph use in financial reporting.

The results suggest that graphical disclosure is very common in Norway. Eighty-three percent of companies included graphs in their annual reports, with an average number of 15 graphs per company. Significant correlations were found between the number of graphs and the number of pages in the annual report and between the number of graphs and the total asset value of the company. The great majority (98.2%) of graphs appeared in the management report, and within the management report the key figures section exhibited the highest

number of graphs (23.5%). Financial variables were slightly more graphed (52%) than non-financial variables (48%), and the four most widely graphed financial variables were revenue, EBIT, EBITDA and net income. The most used graph type were column graph, both by number of graphs (53%) and by number of companies (95%). All companies used colors in graphs and 67 percent of all graphs used the company's logo color.

Unlike most previous studies, no evidence of selectivity distortion was found. However, there was evidence of measurement distortion. Seventeen percent of all key financial variable graphs were materially distorted. The graphical distortions were more often unfavorable, than favorable, to the company. This suggested that there was no intention to mislead and that measurement distortion may result from lack of knowledge on the subject. A high degree of presentational enhancement was found, with a total of 219 violations, corresponding to 1.4 violations per graph. However, there was variation in severity and many of the violations could be considered non-intentional.

The use of graphs in annual reports has been studied in several countries by now. However, to the best of our knowledge, it has not been studied in Norwegian listed companies before. Thus, there was a need to analyze this subject in Norway. This study was based on a sample from Oslo Stock Exchange. Future research could investigate all companies listed on the Oslo Stock Exchange, and international comparative studies within the Scandinavian countries could also be considered. In addition, to get more insight on the evolution of graphical disclosure in Norwegian companies, longitudinal studies could be performed.

Based on the findings in this study, as well as previous research, it is advisable that specific formal accounting guidelines for graphical disclosure of financial information are developed. This would benefit both preparers and users of annual reports by increasing knowledge and awareness on the subject. In addition, both preparers and users of graphs in annual reports ought to be aware of the existence of misleading graphs.

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