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Graph Usage in Financial Reports:

Evidence from Portuguese Listed Companies

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Abstract

When assessing investment options, investors focus on the graphs of annual reports, despite lack of auditing. If poorly constructed, graphs distort perceptions and lead to inaccurate decisions. This study examines graph usage in all the companies listed on Euronext Lisbon in 2013. The findings suggest that graphs are common in the annual reports of Portuguese companies and that, while there is no evidence of Selectivity Distortion, both Measurement and Orientation Distortions are pervasive. The study recommends the auditing of financial graphs, and urges preparers and users of annual reports to be wary of the possibility of graph distortion.

Keywords: Graphs, Graph Distortion, Financial Reporting, Portugal

1. INTRODUCTION

Corporate annual reports are important documents and investors rely heavily on them when making investment decisions (Penrose, 2008). Despite the complexity and importance of annual reports, they are not subject to homogenous regulation principles. Addressing the need for accurate information when assessing investment possibilities, the financial section is subject to auditing, following governmental and professional standards (Penrose, 2008). On the other hand, although it is arguably the one which most influences the readers' perception of a company's financial situation (Canniffe, 2003), the narrative section is not subject to auditing by independent accountants and its contents are not strictly regulated (Fisher & Hu, 1989). In an attempt to enhance the external perception of their financial position, companies may alter the amount and type of voluntary disclosed information (Penrose, 2008). Some of this voluntary information is presented graphically.

Graphs provide an interesting case because, even though they often present audited values, the graphs themselves are exempt from appropriate regulation, which would ensure a truthful correspondence between graph construction and the underlying financial information (Steinbart, 1989). As the graphs are not audited, there is margin for misleading representation of data, as several studies have shown (Beattie & Jones, 1992; Chekkar & Martinez, 2011; Courtis, 1997; Ianniello, 2009; Wozniak & Ferreira, 2011).

In 2010, the average annual report of FTSE100 companies was 175 pages long, with 6 spreading for more than 300 pages (ACCA, 2012). Faced with such lengthy annual reports, many investors disregard the texts and base their decisions solely on the graphs (Zweig, 2000). As investors spend on average 15 minutes per report (David, 2001), relying on visual information is crucial and it is thus essential that graphs display data faithfully.

Provided that graphs are present in the annual reports and that readers prioritize them when reading and making investment decisions, it is crucial to analyze how companies make use of graphs and whether or not these present a distorted view of the companies' final position. The purpose of this research is to analyze the usage of graphs in the annual reports of Portuguese listed companies, contributing to the extension of literature on the subject.

This research is composed by five sections. After the Introduction, Section 2 describes key concepts and provides a summary of previous studies regarding usage of graphs in annual reports, principles of graphic construction and accounting regulation. Section 3 introduces the methodology, the research questions (hereafter RQ), the model of analysis, the sample and selection criteria, and exploratory data. Section 4 analyses and interprets the data collected and answers to the research questions. Finally, Section 5 compiles the conclusions of the study, presents suggestions for future research and provides recommendations for regulators and preparers, and caution to users of annual reports.

2. LITERATURE REVIEW

2.1 Normative studies:

What is a graph?

Graphs[1] are visual displays which express and summarize quantitative data and relations among discrete values (Frownfelter-Lohrke & Fulkerson, 2001; Kosslyn, 1989) through a combination of abstract marks. There are several types of graphs, such as line, bar/column, pie and pictorial, being each graph variety better suited to display a specific kind of information (Beattie & Jones, 1992). In spite of their variety, graphs have two main functions: to analyze data and to communicate information. The graphs present in annual

[1] Oxford Dictionary defines 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."

reports generally serve the purpose of communicating financial information (Beattie & Jones, 2008; Frownfelter-Lohrke & Fulkerson, 2001). Graphs are better than tables at highlighting trends and relations between the different values (Vessey & Galletta, 1991). In addition, while color in tables hinders information extraction, color in graphs improves accuracy in comprehension and learning tasks (Hoadley, 1990).

Principles of Graph Construction

There is a limit to the amount of information humans can process, thus, when solving a problem, people attempt to diminish the effort they exert in processing information (Newell & Simon, 1972). Forced to face complex scenarios, people tend to use simplifying strategies, being more restrictive in the use of the information available. These strategies are a good option, considering people want to achieve both accuracy and economy of effort (Payne et al, 1993). This tendency makes one prone to be misled by visual information, as graphs provide a more instantaneous overview of the relations between data. Adding to this concern, experiments show that most people do not detect subtle biases in data presentation (Ricketts, 1990). Out of plausibility, incorrect values remain unnoticed. This situation is aggravated by the perceived credibility of annual reports, as the users of companies' annual reports regard those documents as highly credible (Moskowtiz, 2000). Despite this aura of reliability, graphs are often built in a way that makes them portray data inaccurately, even when reporting on serious issues of public interest (Tufte, 1983).

When well-constructed, graphs display data accurately, hold the readers' attention, have a straightforward interpretation (Kosslyn, 1989; Schmid & Schmid, 1979) and facilitate the communication and understanding of quantitative information. However, when poorly designed, graphs may provide distorted data displays, manipulating the reader's perception of the performance of a company (Beattie & Jones, 1992; Tufte, 1983). These mislead

perceptions have been shown to actually alter the choices of their users, diminishing decision accuracy (Arunachalam et al, 2002). Nevertheless, regulation on graphs is scarce or inexistent and several studies have provided evidence for the existence of inadequately constructed graphs, replete of distortions (Beattie & Jones, 1992; Frownfelter-Lohrke & Fulkerson, 2001; Tufte, 1983).

Living in an increasingly visual society, with a large proportion of the population immersed in visual stimuli, such as television and advertisement (Courtis, 1997), it is easy to take for granted one's ability to construct and read graphs. However, graph construction is no so straightforward. Throughout the years, studies have analyzed and synthesized the characteristics of a well-designed graph, which would ensure accurate data disclosure independently from the users and their different levels of proficiency. Summarizing the conclusions of previous studies, the acceptable principles for proper graph construction are the following:

- The representation of numbers, as physically measured on the graph's surface ought to be directly proportional to the numerical values represented (Tufte, 1983, p.56);
- To avoid ambiguity and distortion, titles, labels, key and data explanations should be clearly written on the graph itself (Kosslyn, 1989; Tufte, 1983, p.56);
- Any mark variation must be easily noticed (Kosslyn, 1989);
- Sharp contrasts and excessive coloring should be avoided, as to highlight the information conveyed and not disturb the correct analysis of the graph (Kosslyn, 1989);
- Graph construction should follow cultural conventions and thus time should increase from left to right or from bottom to top (Kosslyn, 1989);

- The axis should both have their origin in the same point, values on the vertical axis should increase going upwards and values on the horizontal axis should increase towards the right (Kosslyn, 1989);
- Truncated axis and transformed scales should be avoided (Kosslyn, 1989).

Graphic Distortion

There are four types of graphic distortion: Selectivity Distortion, Measurement Distortion, Orientation Distortion and Presentational Enhancement.

Selectivity Distortion reflects the decision to include graphs in the annual report. Additionally, whenever a graph is included, there can be further selectivity in the choice of which variables to present (Beattie & Jones, 1992). Bias in this selection may portray the company in a light that does not reflect the truth. *Selectivity Distortion* may be a symptom of impression management (Godfrey et al., 2003).[2]

Measurement Distortion relates to graph construction. Whenever the graphic representation of numbers is not directly proportional to their numeric value, there is an instance of *Measurement Distortion* (Beattie & Jones, 1992). This kind of distortion may arise from the existence of a "non-zero axis, a broken axis or a non-arithmetic scale" (Beattie & Jones, 1992). However, the distortion does not have to necessarily result from a particular cause; providing the graph does not display a direct proportion between surface and the numerical value represented, there is *Measurement Distortion* (Beattie & Jones, 1992). *Measurement Distortion* can be objectively quantified through the *Graph Discrepancy Index*[3], (hereafter,

[2] *Impression management* is the effort to depict a company's performance as being better than it is in reality. (Godfrey & Ramsay, 2003)

[3] $GDI = \left(\frac{Percentage\ Change\ in\ the\ Graph\ Surface\ (cm)}{Percentage\ Change\ in\ the\ Data\ Displayed} - 1\right) \times 100\%$

GDI) which Taylor & Anderson (1986) adapted from Tufte's "lie factor". [4] An interpretation standard states that graphs whose GDI exceeds the absolute value of five per cent are materially distorted (Tufte, 1983, p.57). Furthermore, Arunachalanm et al. (2002) found that distorted graphs can, not only alter perceptions, but also significantly affect the decisions of the users of annual reports, even when accompanied by accurate numeric labels.

Orientation Distortion is related to the slope of graphs. If the slope of a graph is not an optimal 45º angle or close, the readers' judgment accuracy is negatively affected (Beattie & Jones, 1997), since whenever line segments are close to vertical or horizontal, evaluations of slope are deemed inaccurate, resulting in faulty judgments (Cleveland & McGill, 1985).

Finally, *Presentational Enhancement* occurs whenever one or more elements of a graph impede an accurate understanding of the data displayed. This distortion arises from, among other things, three-dimensional elements, lack of tittles, ambiguous labels and colors whose intensity is associated with numeric values (Beattie & Jones, 1997).

2.2 Empirical Studies

Various studies have been developed on the use of graphs in the annual reports of companies from several countries.[5] Penrose (2008) provides an extensive review on this subject and concludes that factors, such as country of origin, firm size and exchange listing influence the voluntary disclosure of companies.

The vast majority of companies feature graphs in their annual reports. Studies based on the UK, the US and a group of 11 countries found that 79% of companies include at least one graph in their annual report (Beattie & Jones, 1992; Frownfelter-Lohrke & Fulkerson, 2001;

[4] There is also an alternative formula to calculate graph distortion, the Relative Graph Discrepancy index (RGD). (Mather et al, 2005) Since subsequent studies continue using the GDI, with one using both the GDI and the RGD, for comparison purposes in this study the use of the GDI formula was favored.

[5] To the best of our knowledge, the countries analyzed in individual studies are the US, UK, Italy, Portugal, Australia, Hong Kong, Turkey, Taiwan and France.

Steinbart (1989). Examining the reports of 52 Italian companies[6], Ianiello (2009) found that 85% of them used graphs, with an average of nine graphs per report. Australian and French companies display a higher incidence of graphs, with 89% of companies showing at least one graph (Beattie & Jones, 1999; Chekkar & Martinez, 2011). Focusing on Hong Kong, Courtis (1997) reported the lowest percentage[7], as only approximately 35% of all public listed companies included graphs in their annual report, with graphs averaging 5.3 per report. Results obtained for Portugal provide a sharp contrast with Hong Kong, since 91% of listed companies display at least one graph in their 2009 annual report, with the average number of graphs per annual report being 26 (Wozniak & Ferreira, 2011). When comparing the extent of graph usage by US and non-US (and non-Canadian) companies listed on major US stock exchanges, Frownfelter-Lohrke & Fulkerson (2001) found that, on average, non-US companies relied significantly more on graphs than their US counterparts.

Regarding content, companies are more likely to use graphs to present financial data, rather than non-financial information (Frownfelter-Lohrke & Fulkerson, 2001). In the US, Steinbart (1989) concludes that the most displayed variables are sales, income and dividends, with 27.5% of graphs presenting one of these variables. Beattie & Jones (1992; 1997) find that 65% of 240 UK listed companies and 72% of Australian companies graphed at least one key financial variable (hereafter, KFV). Similarly, Chekkar & Martinez (2011) conclude that French companies display 64% of graphs with financial information.

Considering distortions, a significantly large proportion of graph inaccuracies appear to be selective, suggesting they are actively designed to enhance the company's financial position and performance (Beattie & Jones, 1992). Steinbart (1989) found companies whose net

[6] Largest by market capitalization as of 31 December 2005.
[7] The fact that this study is older may explain the smaller prevalence of graph usage.

income had increased significantly to be more prone to graph one KFV than companies whose net income had decreased, 74% in contrast to 53% of companies.

Further analysis shows that 52% of graphs are not properly constructed and are misleading, with up to 72% companies presenting at least one misleading graph (Courtis, 1997). Calculating the GDI, the graphs of US companies are, on average, distorted 81%, while their non-US counterparts display higher levels of distortion, 173% (Frownfelter-Lohrke & Fulkerson, 2001). In Italy, Ianiello (2009) concludes that approximately 25% of the graphs are materially distorted, with distortions favorable to the company being more frequent than the unfavorable, although there is no significant evidence of selectivity. Beattie & Jones (1992) report that in Australia, 34% of graphs in annual reports present material distortions. In 2009, Portuguese listed companies display measurement distortion in 73% of graphs, selectivity distortion and presentational enhancement (Wozniak & Ferreira, 2011).

From the literature, it is clearly urgent to develop formal guidelines and protocols, as to ensure both preparers of annual reports and auditors are able to prevent and detect graphic distortions. This work project contributes to the literature by adding the most recent year to the study of graph usage by Portuguese listed companies and examine if errors diminished or modified.

3. RESEARCH DESIGN

3.1 Research Questions

This research analyzes the use of graphs in the annual reports of all the companies listed in the Euronext Lisbon in 2013, which is the most recent period of publicly available data. In order to do so, specific exploratory and research questions are detailed below:

RQ1: *Do Portuguese companies present graphs in their annual reports? If so, in which sections are graphs displayed?*

This is an exploratory question and, bearing in mind a previous made by Wozniak & Ferreira (2011), it is expected that Portuguese companies display information graphically.

RQ2: *What types of graph are present in the annual reports?*

Graph types studied are: bar, column, line, pie, area, doughnut, bubble, radar and combined.

RQ3: *What are the colors used in graphs? Are the colors of the graphs being actively used for communication purposes?*

RQ4: *What kind of information is communicated through graphs in annual reports? Is financial information more prevalent than non-financial information?*

RQ5: *Are the graphs designed according to recommended guidelines? If they are not, is the distortion significant?*

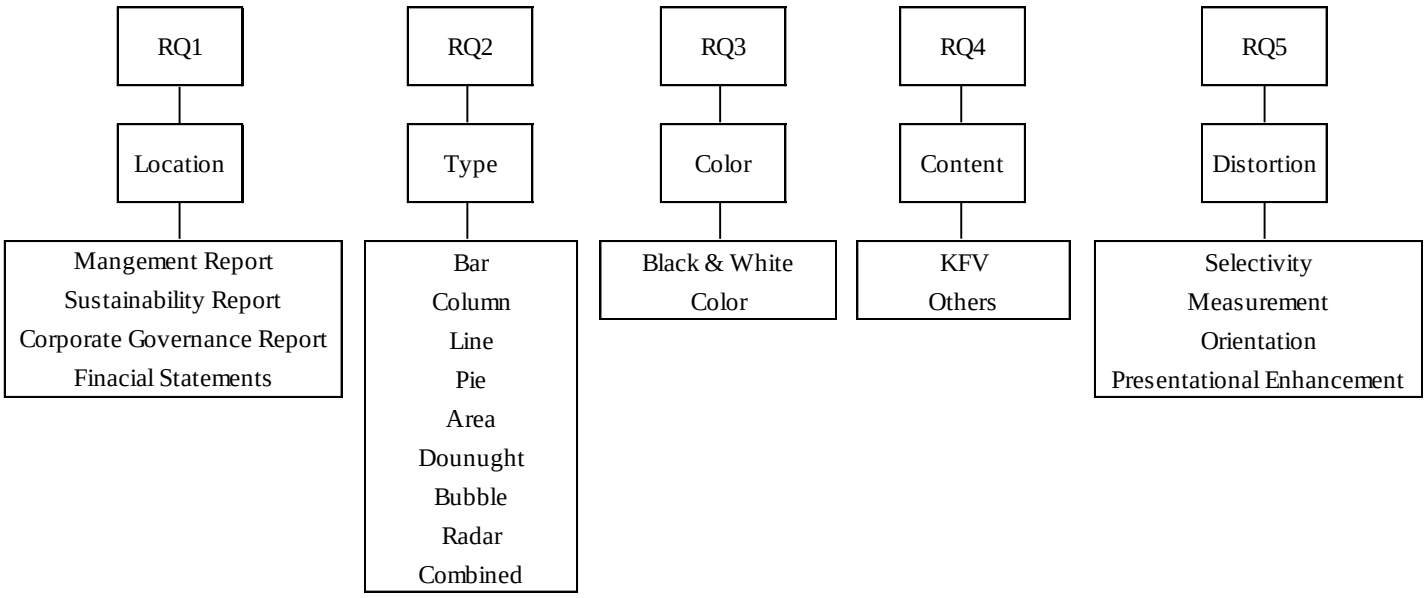
RQ6: *Does company performance relate to the distribution of KFV graphs?*

3.2 Methodology

In order to answer to the research questions, an Excel database[8] was created to systemically analyze graphs through five variables: type, color, location, content and distortion.[9] Each of these five variables was further divided[10] into several smaller categories.[11] This univariate analysis answers to the research questions from RQ1 to RQ5. To better answer RQ5, the GDI of graphs is calculated and evaluated according to the criteria proposed by Tuffte (1983), which rules that graphs whose GDI is above five per cent are materially distorted. To answer RQ6, a x^2 test for independence was conducted, to test whether or not the information presented is independent from company performance. Figure 1 shows a summary of the research design, its variables and RQ.

[8] The database is composed by five sheets for a total of approximately 20,500 cells of data.
[9] There is some degree of subjectivity in this analysis as color perception is inherently subjective. Furthermore, because annual reports do not all follow the same structure, the variable location is subject to some systemization in order to accommodate every company's circumstances.
[10] Since the categories for evaluation were proposed *a priori*, it was necessary to reevaluate them during the analytic process, such as including a risk management category in the content analysis.
[11] Since Euronext Lisbon occupies the sixth place in the ranking of stock exchanges which disclose more information on sustainability Corporate Knights Capital (2014), in order to assess if that information was being disclosed graphically, a finer analysis on human resources and sustainability indicators was conducted on the content variable.

Figure 1: Research Model and Variables



3.3 Sample and Data

This research considers the entire population of companies listed on the NYSE Euronext Lisbon as of 30 of December of 2013[12], for an initial sample of 51 reports.[13] In order to analyze these companies' graph usage in financial reporting, their consolidated annual reports for the year of 2013[14] were extracted either, from their websites or from CMVM's[15] website, according to their availability, and sometimes from both for validity reasons. These annual reports provided the hand collected data which was then analyzed and codified through the above mentioned Excel database.

[12] Please refer to Appendix 1 for the complete list of companies considered in this work.
[13] In the initial sample of 51 companies, annual reports have 11,898 pages, for an average of 233.29 pages and a median of 220. NEXPONOR SICAFI S.A. has the minimum, 27, while BANIF S.A. has the maximum, 529.
[14] Three companies, BENFICA – FUTEBOL SAD, SPORTING CLUBE DE PORTUGAL – FUTEBOL SAD and FUTEBOL CLUBE DO PORTO – FUTEBOL SAD, have a different reporting period, coinciding with their operating cycle, and ending on June 30th. For the purpose of providing more timely and relevant information in the study, the most recent reports, from 2013/2014, ending on June 30th, 2014, were considered.
[15] *Comissão do Mercado de Valores Mobiliários,* Stock Market Commission.

Following a preliminary analysis, three companies did not include any graph in their consolidated annual report and were thus excluded from the final sample.[16] Consequently, the final sample is composed of 48 companies, corresponding to 94% of the entire population of listed companies. The total number of graphs is 1,104, for an average number of 23 graphs per report and a median of 16.5.[17] The minimum number of graphs is one, by the company IMOBILIÁRIA CONSTRUTORA GRÃO PARÁ S.A. and the maximum is 98, by BANCO BPI S.A. This broad range and a standard deviation of 23.7, suggest the existence of very disparate approaches to graph usage. Companies in the PSI20[18] have an average of 39.8 graphs per annual report, and the remaining companies have an average of 11 graphs per annual report.

Analyzing through industries, companies in the "Utilities" display the highest average number of graphs per annual report, 52, followed by "Financials" with 49.8. These two industries have also the highest average number of pages per annual report, 324 and 320.9, respectively, and the highest average value for Total Assets.[19] Nevertheless, "Oil & Gas" is the industry featuring the highest average of graphs per page, 0.24.

Comparing to results from graph disclosures by Portuguese listed companies in 2009 (Wozniak & Ferreira, 2011), there has been an increase in the prevalence of graphs, from 91% to 94% of companies, despite a decrease in number, from 1,262 to 1,104 graphs.[20]

[16] The excluded companies are Grupo MEDIA CAPITAL, SGPS, SA; NEXPONOR - SOCIEDADE ESPECIAL DE INVESTIMENTO IMOBILIÁRIO DE CAPITAL FIXO, SICAFI, S.A. and VAA - VISTA ALEGRE ATLANTIS - SGPS, SA.

[17] The mean and the median were calculated from the final sample of 48 companies which utilize graphs. For values referring to the initial sample please consult Appendix 2.

[18] PS1 20, Portuguese Stock Index, is the group of the 20 biggest companies listed on the Euronext Lisbon.

[19] According to three regressions run, with a significance level of 5%, there is no significant correlation between the number of graphs and the number of pages per annual report, nor between the number of graphs and the Total Assets of a company. (The p-value is 4.09 and 3.12, respectively.) There is, however, a significant correlation of 11% R^2 between the Total Assets of a company and the number of pages of its annual report. (The p-value is 0.0193.)

[20] Both researches have a final sample of 48 annual reports containing graphs, and have in common 43 (90%) companies.

The vast majority of graphs appear in the Management Report, with particular incidence in the business and financial overview sections, 248 (22%) and 212 (19%), respectively. The key highlight section contains 182 (16%) graphs and some companies, such as SUMOL+COMPAL S.A., only include graphs in this section. There are more graphs in the human resources and social responsibility section, 146 (13%), than in the macroeconomic section, 115 (10%).[21]

4. RESULTS

4.1 Graph Construction

Format (RQ 2)

The analyzed companies consistently display in their annual reports nine types of graphs: area, bar, bubble, column, combined, doughnut, line, pie and radar.[22] Out of the companies analyzed 11 (23%) use four types of graph.[23]

Column graphs are the most numerous, 578 (52%), and the most prevalent, as 41 (85%) companies display at least one column graph, a small increase from their prevalence in 83% of annual reports in 2009.[24] (Wozniak & Ferreira, 2011) Line graphs follow, being present in 34 (71%) annual reports. Comparing with data from 2009, when 92% of companies featured at least one line graph in their report (Wozniak & Ferreira, 2011), it is possible to notice a decrease of 23% in the prevalence of line graphs. Pie graphs also decreased, going from being present in 77% (Wozniak & Ferreira, 2011) of annual reports to merely 40%.

[21] The possible reasons behind graphs distribution among sections of the annual report are beyond the scope of this research.

[22] In order to facilitate comparisons with previous studies, four types of graphs, namely combined, bubble, doughnut and radar, were also categorized and analyzed under the broader category "other". Bar and column graphs are also considered categories for the purpose of this study and both further fragmented into simple, stacked and clustered.

[23] The company using the maximum variety of graphs is BANCO COMERCIAL PORTUGUÊS S.A., with seven types of graph.

[24] Out of column graphs, the most frequent are the simple column graphs, which represent 58% of all column graphs. For a more detailed graph format overview, please refer to Appendix 3.

Other types of graph and line graphs are also significantly present, corresponding to 18% and 15% of all graphs featured. More traditional formats, such as column and line, are predominant, perhaps to favor a more direct interpretation. Table 1 summarizes this analysis.

Table 1: Graph Format Overview

Graph Format		Number of Graphs	% of Category	% of Total Graphs	Number of Companies with at least one Graph	% of Total Companies
BAR	**Total Bar Graphs**	**107**	**100%**	**10%**	**18**	**38%**
COLUMN	**Total Column Graphs**	**578**	**100%**	**52%**	**41**	**85%**
LINE	**Total Line Graphs**	**169**	**100%**	**15%**	**34**	**71%**
PIE	**Total Pie Graphs**	**54**	**100%**	**5%**	**19**	**40%**
AREA	**Total Area Graphs**	**2**	**100%**	**0%**	**2**	**4%**
OTHER	Doughnut Graphs	66	34%	6%	18	38%
	Bubble Graphs	2	1%	0%	2	4%
	Radar Graphs	4	2%	0%	2	4%
	Combined Graphs	122	63%	11%	25	52%
	Total Other Graphs	**194**	**100%**	**18%**	**30**	**63%**
TOTAL	**Total Graphs**	**1104**	**-**	**100%**	**48**	**100%**

Usage of Color (RQ 3)

The entire sample of companies analyzed use color, as opposed to black and white, in at least one of their graphs. Two companies[25] present black and white graphs, but these correspond to only 0.27% of the total graph sample. Comparing with data from 2009, when 7% of graphs were colored in black and white (Wozniak & Ferreira, 2011) there is evidence of an increasing preference for the usage of color. Studies have shown color to be a performance enhancer in comprehension and learning tasks (Hoadley, 1990), thus an increase in the usage of color points towards a more effective communication. When selecting which colors to use, 38 (79%) companies opted towards the colors of their logo, possibly for a coherent display of brand image and to blend harmoniously with the general

[25] BANCO ESPÍRITO SANTO, SA and MARTIFER SGPS, SA.

aesthetic of the report. Furthermore, repetition enhances understanding and assimilation, thus continuously using the same colors may help reinforce information.[26]

4.2 Content (RQ 4)

Most information presented graphically can be included in one of five categories: capital markets, financial information, macroeconomic data, human resources, and sustainability.

Information on capital markets, such as share price, is the most prevalent among companies, with 36 (75%) of them presenting at least one graph on it.[27] The annual report is approved by the shareholders and information on capital markets is of great interest to them, which might explain why so many companies highlight it through graphs.

Following, 30 (63%) companies display graphically information on turnover, corresponding to 16% of all graphs.[28] Column graphs are responsible for 71% of these displays.

A considerable percentage of companies, 44%, 31% and 42% choose to display information on EBITDA, EBIT and Net Income, respectively. Information related to these three variables is present in 15% of all graphs.[29] Out of these components, EBITDA is the most displayed, corresponding to 53% of the sum of the three. These indicators are 67% of the time displayed through column graphs. Companies might seek to highlight this information by presenting it graphically, as it is already present in the income statement. This type of information hints on company performance, and is relevant for different categories of users, such as the Net Income for shareholders and the EBIT for managers.

[26] For a more detailed overview of color usage, by graph format and color, please refer to Appendix 4.
[27] The industries which most display information on shares are Telecommunications, 19%, and Consumer Goods, 17%.
[28] The industries most focused on turnover information are Healthcare, Technologies and Basic Materials, where it corresponds, respectively, to 39%, 32% and 31% of all graphs used by those industries.
[29] In the Consumer Goods industry, 61% of graphs are dedicated to these three variables, followed by 33% in the Healthcare industry and 31% in the Basic Materials.

Companies presenting macroeconomic information graphically amount to 42%, being displayed in 14% of all graphs.[30] This information is most commonly expressed through line graphs, 56%, and column graphs, 29%.

Companies also present information on Human Resources[31] and Sustainability[32], 48% and 27%, respectively, adding up to 7% and 6% of all graphs. In Human Resources, employee number and health, safety and satisfaction both amount to 22% of graphs. Country distribution and mobility corresponds to 13% of this category, followed by age and training, each with 9%.[33] Considering Sustainability, it is featured in 11% of graphs of both the Utilities industry and, perhaps not surprisingly, the Industrials industry.

Comparing to 2009, when only 29% of companies showed graphs on Human Resources and Sustainability (Wozniak & Ferreira, 2011), more companies are using graphs to disclose this information, 52%. There was also an increase in the number of graphs dedicated to this information, from only five per cent in 2009 (Wozniak & Ferreira, 2011) to 13% in 2013, for a 62% increase. Simultaneously, there are less companies presenting information on capital markets, 75% now and 85% in 2009, and on turnover, 63% now and 75% in 2009 (Wozniak & Ferreira, 2011). From 2009, companies moved towards a more multifaceted overview of their activities, possibly due to decreasing financial performance or due to an increase in the demand for social responsibility by the public.[34]

[30] As much as 75% of all graphs shown by companies operating in the Telecommunications industry display some form of macroeconomic information. Companies in the Financials and Utilities industry also devote, respectively, 18% and 15% of their graphs to this kind of data.

[31] Information on Human Resources covers a broad range of issues: employee number, age, gender, salary, education, seniority, country distribution and mobility, absenteeism, health, safety and satisfaction, and training.

[32] Information on Sustainability issues includes mainly water, energy and wood consumption, as well as waste production and emissions of CO2 and other gases.

[33] Companies in the Oil & Gas, Industrials and Technology industries are those who display more information on human resources, corresponding to 16%, 12% and 10% of all the graphs used.

[34] The determination of the causes behind this shift is beyond the scope of this work.

4.3 Distortion (RQ 5 and 6)

The analysis concentrates on the four different types of graph distortion introduced in the Literature Review: *Selectivity Distortion*, *Measurement Distortion*, *Orientation Distortion* and *Presentational Enhancement*.

Selectivity Distortion

Selectivity Distortion is closely related to impression management (Godfrey et al, 2003), and reflects the choice of whether or not to include graphs for a specific parameter. If *Selectivity Distortion* is present, the company will be portrayed more favorably than its performance justifies. (Beattie & Jones, 1992) For the purpose of this study, performance was evaluated as favorable or unfavorable, depending on whether the parameters analyzed increased or decreased from 2012 to 2013. The variables chosen were EBITDA, EBIT and Net Income, three of the variables graphed by the largest number of companies. These variables are also related to company performance and essential to shareholders, being also audited and displayed in the income statement. The results are summarized in Table 2.

Table 2: EBITDA, EBIT and Net Income Selectivity Distortion

	Number of Companies with Unfavorable Change	Presenting Graphs	% of Companies with Unfavorable Change Presenting Graphs	Number of Companies with Favorable Change	Presenting Graphs	% of Companies with Favorable Change Presenting Graphs
EBITDA	24	8	33%	24	13	54%
EBIT	27	7	26%	21	8	38%
Net Income	24	12	50%	24	8	33%

Conforming to previous studies, only 33% of companies with an unfavorable EBITDA change chose to display that information graphically, as opposed to 54% of companies with favorable changes who chose to do so. Similarly, only 26% of companies with unfavorable EBIT change showed that information, as opposed to 38% of companies with a favorable change. Surprisingly, the same is not true for Net Income, as 50% of companies with an

unfavorable Net Income change opted to disclose this information graphically, contrary to only 33% of companies with a more favorable performance.

In order to verify if there is evidence of manipulation and therefore of *Selectivity Distortion*, a x^2 test for independence was undertaken. This test aimed to determine if the decision to present this type of information graphically was independent form the company's performance. Table 3 summarizes the results of the test.

Table 3: Relation between Company Performance and KFV Graph Display

EBITDA	**Graphed**	**Not Graphed**	**Total**
Favorable Change	13	11	24
Unfavorable Change	8	16	24
Total	21	27	48

x2:	2.12
critical value:	3.84
p -value:	0.15

EBIT	**Graphed**	**Not Graphed**	**Total**
Favorable Change	8	13	21
Unfavorable Change	7	20	27
Total	15	33	48

x2:	0.81
critical value:	3.84
p -value:	0.37

NET INCOME	**Graphed**	**Not Graphed**	**Total**
Favorable Change	8	16	24
Unfavorable Change	12	12	24
Total	20	28	48

x2:	1.37
critical value:	3.84
p -value:	0.24

According to the test, there is not sufficient evidence to dismiss the hypothesis that the variables are independent. Consequently, there is no evidence of *Selectivity Distortion.* In this parameter, graph usage has greatly improved comparing with 2009, when it was reasonable to assume that companies were presenting graphs selectively (Wozniak & Ferreira, 2011). Considering how more companies presented graphs on Net Income when faced with unfavorable changes, one possibility is that absence of apparent *Selectivity Distortion* results from companies' lack of knowledge on the subject. There is, however, not enough information to specify a cause.

Measurement Distortion

One of the major aspects of *Measurement Distortion* is the GDI. As addressed in the Literature Review, the GDI, adapted from Tufte's "lie factor" (Tufte, 1983, p.57), ascertains whether or not a graph presents a direct proportion between surface and the numerical value represented (Taylor & Anderson, 1986). This research follows the standard for the interpretation of GDI values and assumes that only graphs whose GDI exceeds the absolute value of five per cent are materially distorted (Tufte, 1983, p.57). Since Net Income is one of the most graphically displayed financial variables, and its value is written in the auditor's report, it was deemed important to ascertain if its graphic representations were reliable. As a result, the GDI was calculated[35] for the graphs displaying Net Income.[36]

Material distortions are present in 56% of the graphs analyzed.[37] Out of the materially distorted graphs, 53% understate the underlying trend and 47% overstate it. The vast majority of distortions, 73%, are favorable to the companies, as they enhance favorable trends and mitigate the unfavorable ones. Table 4 summarizes these results.

Table 4 – GDI Analysis

	Understates	**% of Distorted Graphs**	**Overstates**	**% of Distorted Graphs**	**Total**	**% of Distorted Graphs**
Favorable Trend	3	20%	6	40%	9	60%
Unfavorable Trend	5	33%	1	7%	6	40%
Total	8	53%	7	47%	15	100%

Understating of Unfavorable Trend	5	
Overstating of Favorable Trend	6	
Total Company Favorable Distortions	**11**	**73%** of Distorted Graphs
Understating Favorable Trend	3	
Overstating of Unfavorable Trend	1	
Total Company Unfavorable Distortions	**4**	**27%** of Distorted Graphs

[35] Refer to Appendix 6 for an example of a GDI calculation.

[36] Only column and bar graphs were considered in this analysis. There were 28 column graphs and four bar graphs, but since four of the column graphs and one bar graph did not present at least one of the required data (scale or absolute value; year sequence), they were excluded. The final sample is composed by 27 graphs.

[37] In terms of GDI, BANCO BPI, SA appears as a good example, since none its five analyzed graphs displayed material distortions.

Measurement Distortion may result from lack of zero base line, broken axis and non-arithmetic scales (Beattie & Jones, 1992). Out of a total of 979 graphs[38] only 281 (29%) display a clearly indicated zero base line. Furthermore, only 358 graphs (37%) present a vertical[39] axis with scale. The vast majority of graphs lack these elements, which are fundamental for a good data interpretation.[40] Additionally, 26% of graphs do not present labels with the exact values of the data being analyzed and 3% display multiple vertical scales, which ought to be avoided as they impede correct readings. The misleading potential of these graphs leaves readers vulnerable to bias and consequent inaccurate decisions.

Orientation Distortion

Orientation Distortion is associated with the slope of the graphs, which, when not at an optimal 45º angle, affects interpretation and precludes correct judgments (Beattie & Jones, 1997). As with the GDI calculation, this research considered the graphs displaying Net Income[41], as it is an important variable of company performance and an audited KFV, present in graphs of 42% of annual reports and confirmed in the auditor's report.

Out of the graphs analyzed, none displayed a 45 degree angle. The most approximate value was of 48 degrees, displayed by a column graph. The average angle was 26 degrees, with the minimum and the maximum being one and 70 degrees, respectively.[42] *Orientation Distortion* is pervasive in this sample, as the graphs studied do not enable a smooth reading and interpretation. Three graphs have an angle of one degree, meaning it is impossible to have an understanding of the true evolution of the data. Such residual slopes, of one or two

[38] Due to differences in design resulting in distinct graphs construction principles, only bar, column, line, area, bubble and combined graphs were considered. Pie, doughnut and radar graphs were excluded.
[39] For bar graphs a horizontal axis was considered.
[40] Please refer to Appendices 7 and 8 for examples of properly and improperly constructed graphs.
[41] Only column and bar graphs were considered in this analysis. There were initially 28 column graphs and 4 bar graphs. However, because three column graphs and one bar graph did not present a sequence of at least two years, they were excluded. The final sample is thus composed by 28 graphs.
[42] Please refer to Appendix 9 for examples of *Orientation Distortion*.

degrees, understate the perception of change, and ought to be adjusted as to provide a more accurate reading.

Presentational Enhancement

There is *Presentational Enhancement* whenever one or more graph components hinder the correct interpretation of the data displayed (Beattie & Jones, 1997). This distortion arises from violations of the graph construction principles discussed in the Literature Review.

Overall, there are 2,064 of the above mentioned violations, corresponding to an average of 1.9 unconformities per graph. Among the graphs analyzed, 6% did not contain a title and 1% did not include a label of the data being presented. Furthermore, 71% of graphs[43] do not have a clearly signaled zero base line. The absence of these elements, particularly in graphs displaying multiple indicators, inhibits an accurate interpretation and renders them futile. The same is valid for the 34, three per cent, of graphs which include multiple scales[44], and often two different base lines.[45]. As much as 14% of time sequential graphs do not follow the recommended time orientation, horizontally from left to the right, and vertically from bottom to the top. Breaking cultural conventions, these graphs mislead their users.

Three dimensional effects are not pervasive, being present in only 2% of all graphs. Pie graphs are responsible for 48% of all three dimensional features registered, equivalent to 20% of all pie graphs. In effect, 78% of all pie and doughnut graphs do not display slices in the recommended order. Additionally, 14% of them display more than six slices, which impairs interpretation and information extraction.

[43] For structural reasons, only bar, column, line, area, bubble and combined graphs were considered when analyzing vertical or horizontal scales. Pie, doughnut and radar graphs were excluded.
[44] Combined graphs represent 76% of all instances of multiple scales.
[45] For examples of these graphs, please refer to Appendix 8.

5. CONCLUSION

This work project contributes to previous literature by adding one year to the study of the use of graphs in financial reporting in Portugal. It examines the nature and extent of graph usage and whether or not graphs are distorted.

Findings show that 94% of Portuguese listed companies show at least one graph in their annual report. Column graphs are both the most prevalent and the most numerous. The vast majority of companies, 38 (79%), opt to display graphs whose color matches the company logo, suggesting an increase in communication effectiveness. A large percentage of graphs, 31%, display information on four key financial variables: Turnover, EBITDA, EBIT and Net Income. Graphical display of information on capital markets is, however, the most pervasive among companies, present in 75% of all reports.

Considering the principles of graph construction recommended, there are 2,064 instances of unconformity, an average of 1.9 per graph. However, results show no evidence of *Selectivity Distortion*. Nevertheless, 56% of the Net Income graphs examined display significant *Measurement Distortion*, and as much as 73% of distortions are favorable to the companies. *Orientation Distortion* is also pervasive in the same graph sample. These findings suggest that the absence of both explicit guidelines and applicable curriculum on the subject, might be contributing to maintain adverse graph practices.

Future research can cover further data periods, country comparisons, as well as the reasons behind the changes in the information displayed graphically. More importantly, future research can elaborate on regulation to ensure companies engage

in a faithful communication, and also examine the effects of more complex visual displays, such as combined graphs and graphs with movement, on users.

From the results find in this work project, it is advisable that regulators clarify and explicit the auditors' responsibilities concerning graphic voluntary disclosures of information. Preparers and auditors of annual reports should meticulously assess whether or not graphs are presenting information faithfully, particularly when graphs display audited figures, and finally, users of annual reports ought to be wary of the existence of misleading graphs.

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Appendix 1: List of Companies Analyzed

	Company	Sector	Industry
1	Altri, SGPS, S.A.	Industrial Goods & Services	Industrials
2	CTT - Correios de Portugal, SA	Industrial Goods & Services	Industrials
3	Mota-Engil, SGPS, S.A.	Construction & Materials	Industrials
4	Teixeira Duarte, SA	Construction & Materials	Industrials
5	Cimpor - Cimentos de Portugal, SGPS, SA	Construction & Materials	Industrials
6	Imobiliária Construtora Grão Pará, SA	Construction & Materials	Industrials
7	Lisgráfica - Impressão e Artes Gráficas, SA	Industrial Goods & Services	Industrials
8	Martifer - SGPS, SA	Industrial Goods & Services	Industrials
9	Sociedade Comercial Orey Antunes, SA	Industrial Goods & Services	Industrials
10	SDC- Investimentos, SGPS, SA	Construction & Materials	Industrials
11	Sonae Indústria, SGPS, SA	Construction & Materials	Industrials
12	Toyota Caetano Portugal, SA	Industrial Goods & Services	Industrials
13	Banco BPI, SA	Banks	Financials
14	Banif - Banco de Investimento, SA	Banks	Financials
15	Banco Comercial Português, SA	Banks	Financials
16	Banco Espírito Santo, SA	Banks	Financials
17	Caixa Económica Montepio Geral	Banks	Financials
18	Espírito Santo Financial Group, S.A.	Financial Services	Financials
19	Nexponor -, SICAFI, S.A.	Real Estate	Financials
20	Banco Santander Totta, S.A.	Banks	Financials
21	Sonae Capital - SGPS, SA	Financial Services	Financials
22	EDP - Energias de Portugal, SA	Utilities	Utilities
23	EDP Renováveis, SA	Utilities	Utilities
24	REN - Redes Energéticas Nacionais, SGPS, SA	Utilities	Utilities
25	Impresa - SGPS, SA	Media	Consumer Services
26	Jerónimo Martins - SGPS, SA	Retail	Consumer Services
27	NOS, SGPS, SA.	Media	Consumer Services
28	Sport Lisboa e Benfica - Futebol, SAD	Travel & Leisure	Consumer Services
29	Cofina - SGPS, SA	Media	Consumer Services
30	Sonae - SGPS, SA	Retail	Consumer Services
31	Estoril Sol, SGPS, S.A.	Travel & Leisure	Consumer Services
32	Futebol Clube do Porto - Futebol, SAD	Travel & Leisure	Consumer Services
33	Grupo Media Capital, SGPS, SA	Media	Consumer Services
34	SAG Gest - Soluções Automóvel Globais, SGPS, SA	Retail	Consumer Services
35	Ibersol - SGPS, SA	Travel & Leisure	Consumer Services
36	Sporting Clube de Portugal - Futebol, SAD	Travel & Leisure	Consumer Services
37	Portucel - Emp. Celulose e Papel Portugal,SGPS, SA	Basic Resources	Basic Materials
38	Semapa - Sociedade Investimento e Gestão, SGPS, SA	Basic Resources	Basic Materials
39	Inapa - Investimentos, Participações e Gestão, SA	Basic Resources	Basic Materials
40	F. Ramada - Investimentos, SGPS, SA	Basic Resources	Basic Materials

(continued)

	Company	Sector	Industry
41	Galp Energia, SGPS, SA	Oil & Gas	Oil & Gas
42	Compta-Equipamentos e Serviços de Informática, SA	Technology	Technology
43	Glintt - Global Intelligent Technologies, SA	Technology	Technology
44	Novabase, SGPS, SA	Technology	Technology
45	Reditus - SGPS, SA	Technology	Technology
13	Portugal Telecom, SGPS, S.A.	Telecommunications	Telecommunications
47	Sonaecom - SGPS, SA	Telecommunications	Telecommunications
21	Corticeira Amorim - SGPS, SA	Food & Beverage	Consumer Goods
49	SUMOL+COMPAL, S.A.	Food & Beverage	Consumer Goods
50	VAA - Vista Alegre Atlantis - SGPS, SA	Personal & Household Goods	Consumer Goods
51	Espírito Santo Saúde, SGPS, S.A.	Health Care	Health Care

Appendix 2: Sample Overview

	Initial Sample (51)	Final Sample (48)
Total Number of Graphs	1104	1104
Average Number of Graphs per Report	21.7	23
Standard Deviation	23.6	23.7
Minimum	0	1
Maximum	98	98
Median	12	16.5

	PSI 20 (20)	Remaining (28)
Total Number of Graphs	795	309
Average Number of Graphs per Report	39.8	11
Standard Deviation	27	8.8
Minimum	5	1
Maximum	98	32
Median	35	8.5

Appendix 3: Graph Format Overview

		Number of Graphs	% of Category	% of Total Graphs	Number of Companies with at least one Graph	% of Total Companies
BAR	Simple Bar Graphs	68	64%	6%	12	25%
	Stacked Bar Graphs	29	27%	3%	8	17%
	Clustered Bar Graphs	10	9%	1%	7	15%
	Total Bar Graphs	**107**	**100%**	**10%**	**18**	**38%**
COLUMN	Simple Column Graphs	333	58%	30%	39	81%
	Stacked Column Graphs	158	27%	14%	28	58%
	Clustered Column Graphs	87	15%	8%	20	42%
	Total Column Graphs	**578**	**100%**	**52%**	**41**	**85%**
LINE	**Total Line Graphs**	**169**	**100%**	**15%**	**34**	**71%**
PIE	**Total Pie Graphs**	**54**	**100%**	**5%**	**19**	**40%**
AREA	**Total Area Graphs**	**2**	**100%**	**0%**	**2**	**4%**
OTHER	Doughnut Graphs	66	34%	6%	18	38%
	Bubble Graphs	2	1%	0%	2	4%
	Radar Graphs	4	2%	0%	2	4%
	Combined Graphs	122	63%	11%	25	52%
	Total Other Graphs	**194**	**100%**	**18%**	**30**	**63%**
TOTAL	**Total Graphs**	**1104**	**-**	**100%**	**48**	**100%**

Appendix 4: Graph Color Overview

	Black & White	Gray	Blue	Violet	Pink	Red	Orange	Yellow	Green	Brown	Mixture
Bar	0	0	11	8	2	13	47	0	18	0	8
Column	1	9	166	22	48	28	80	5	62	0	157
Line	1	0	24	5	3	9	14	1	18	0	94
Pie	0	0	8	4	2	1	1	1	3	0	34
Area	0	0	1	0	0	1	0	0	0	0	0
Doughnut	0	0	8	2	2	6	1	0	7	0	40
Bubble	0	0	0	0	0	0	1	0	0	0	1
Radar	0	0	0	0	3	0	0	0	0	0	1
Combined	1	0	7	1	23	4	18	4	18	0	46
Total	**3**	**9**	**225**	**42**	**83**	**62**	**162**	**11**	**126**	**0**	**381**
% of Total	**0.27%**	**0.82%**	**20.38%**	**3.80%**	**7.52%**	**5.62%**	**14.67%**	**1.00%**	**11.41%**	**0.00%**	**34.51%**

Appendix 5: Graph Content Overview

	Number of Graphs	% Number of Graphs	Number of Companies with at least one graph	% Number of Companies
Macroeconomic Data	153	13.86%	20	41.67%
Turnover	172	15.58%	30	62.50%
Financial Margins. Ratios and Returns	38	3.44%	15	31.25%
Asset Information	86	7.79%	15	31.25%
Debt Information	34	3.08%	21	43.75%
Equity Information	6	0.54%	6	12.50%
Capital Market Information	67	6.07%	36	75.00%
EBITDA	88	7.97%	21	43.75%
EBIT	40	3.62%	15	31.25%
Net Income	38	3.44%	20	41.67%
Risk	37	3.35%	8	16.67%
CAPEX	21	1.90%	10	20.83%
Human Resources	77	6.97%	23	47.92%
Sustainability	70	6.34%	13	27.08%
Consumer Service	17	1.54%	6	12.50%
Other	160	14.49%	27	56.25%

Appendix 6: Example of a GDI Calculation (Exaggeration of a Favorable Trend)

GDI Calculation

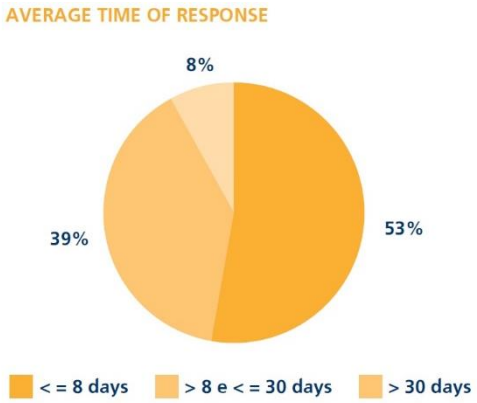
$$cm\ change\ (\%) = \left(\frac{(-1.3) + (-2.9)}{2.9}\right) \times 100\% = 55\%$$

$$€M\ change\ (\%) = \left(\frac{(-740.5) + (-1219.1)}{1219.1}\right) \times 100\% = 39\%$$

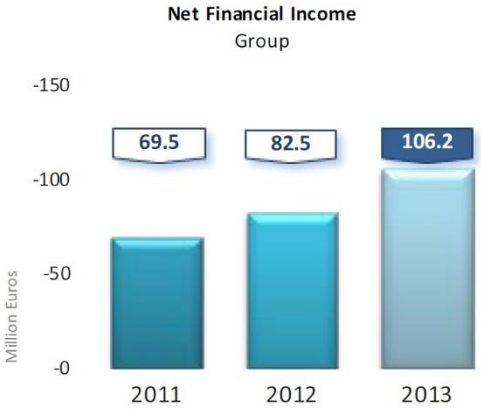
$$GDI\ (\%) = \left(\frac{55\%}{39\%} - 1\right) \times 100\% = 41\%$$

Source: Banco Comercial Português, Annual Report p:10

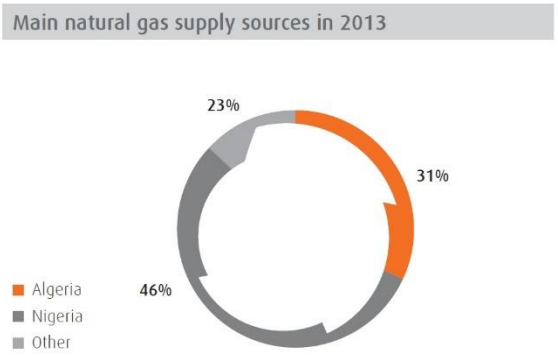
Appendix 7: Examples of Properly Constructed Graphs



Picture 1 – Properly Constructed Pie Graph
Source: Caixa Económica Montepio Geral, Annual Report p:34



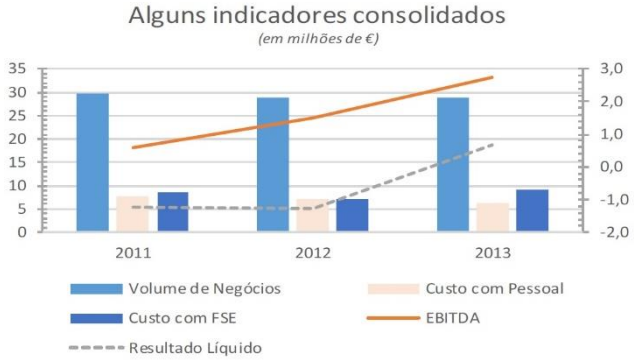
Picture 2 – Properly Constructed Column Graph
Source: Mota-Engil, Annual Report p:15



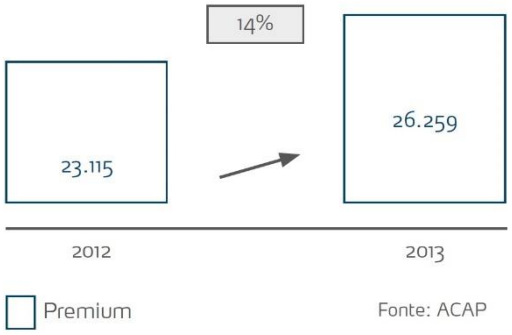
Picture 3 – Properly Constructed Doughnut Graph
Source: Galp, Annual Report p:39

Picture 4 – Properly Constructed Line Graph
Source: Cofina, Annual Report p:5

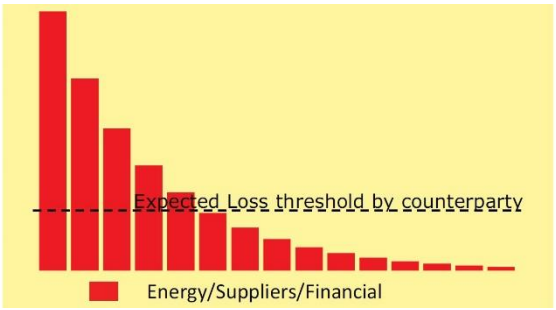
Appendix 8: Examples of Violation of Graphs Construction Principles



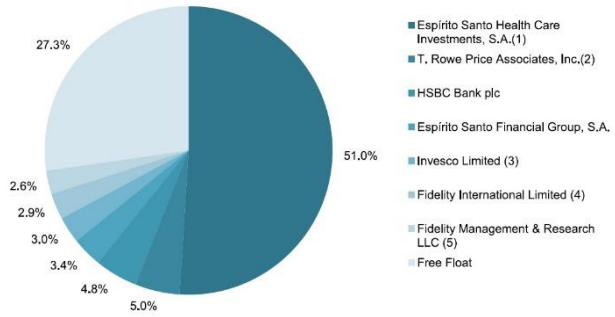
Picture 5 – Two different scales and base lines.
Source: Compta, Annual Report p:18



Picture 6 – Lack of title, unit, zero-base line and scale.
Source: Toyota Caetano Portugal, Annual Report p:12

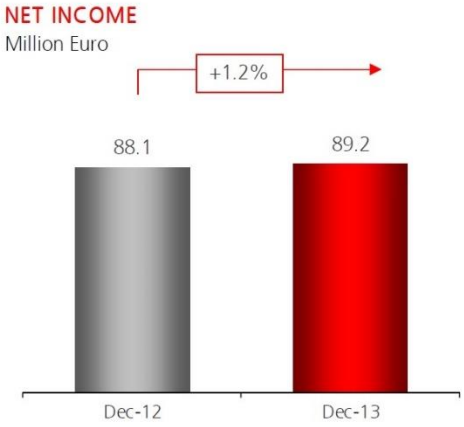


Picture 7 – Lack of title, unit, time, scale and zero-base line.
Source: EDP Renováveis, Annual Report p:116

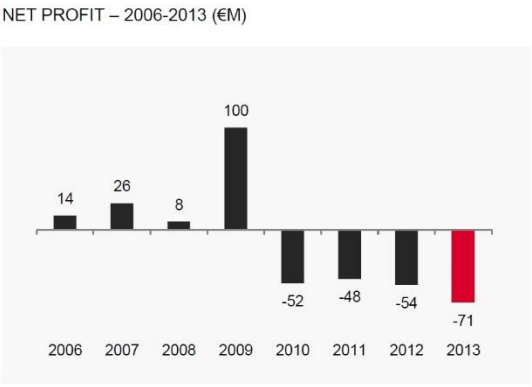


Picture 8 – Lack of title, excessive slices, slices in wrong order.
Source: Espírito Santo Saúde, Annual Report p:103

Appendix 9: Examples of Orientation Distortion



Picture 9 – 1º Angle
Source: Banco Santander Totta, Annual Report p:37



Picture 10 – 18º Angle
Source: Martifer, Annual Report p:10