4-25-2021

The Curious Case of Firm Performance: Why do Comapanies Reverse the Year Order of their Graphs in Annual Reports

Austin Hamil Higginbotham

The Curious Case of Firm Performance: Why Do Companies Reverse the Year Order of their Graphs in Annual Reports?

by

Austin Hamil Higginbotham

An Honors Capstone

submitted in partial fulfillment of the requirements

for the Honors Diploma

to

The Honors College

of

The University of Alabama in Huntsville

April 25, 2021

Honors Capstone Director: Dr. Wei-Cheng Milton Shen

Austin Higginbotham 04/24/2021

Student (signature) Date

Wei-Cheng Shen 04/22/2021

Director (signature) Date

Xuejing Xing Digitally signed by Xuejing Xing Date: 2021.04.23 14:58:29 -05'00'

Department Chair (signature) Date

William Wilkerson Digitally signed by William Wilkerson Date: 2021.04.26 07:52:23 -05'00'

Honors College Dean (signature) Date

HONORS COLLEGE
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Honors College
Frank Franz Hall
+1 (256) 824-6450 (voice)
+1 (256) 824-7339 (fax)
honors@uah.edu

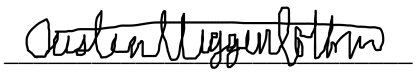
Honors Thesis Copyright Permission

This form must be signed by the student and submitted as a bound part of the thesis.

In presenting this thesis in partial fulfillment of the requirements for Honors Diploma or Certificate from The University of Alabama in Huntsville, I agree that the Library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by my advisor or, in his/her absence, by the Chair of the Department, Director of the Program, or the Dean of the Honors College. It is also understood that due recognition shall be given to me and to The University of Alabama in Huntsville in any scholarly use which may be made of any material in this thesis.

Austin Higginbotham
_____

Student Name (printed)


_____

Student Signature

04/24/2021
_____

Date

Table of Contents

Abstract

Though faithful representation is one of the core tenants of accounting, literature suggests that companies may change the presentation of their performance in financial reporting to alter stakeholders' impressions. There is little empirical evidence on its frequency or causes despite signs existing. The year order of vertical bar charts is usually presented from left to right. By analyzing the 2004-2019 annual reports of the Fortune 100 companies, this research finds that 7.4% of vertical bar charts were presented with reversed year order from right to left, resulting in potential confusion or ambiguity. In total, eighteen companies reversed the year order of their vertical bar charts. Additional analyses show that eleven of those companies reversed year order while observing a decline in firm performance, and eight did so when a new CEO or CFO was appointed. Most of the reversed bar charts appeared nearby comparative financial information and depicted unfavorable trends as upward increases. Evidence on the prevalence of year reversal and its association with firm performance suggests an unignorable phenomenon of impression management that requires additional attention and future research.

I. Introduction

As a formal communication to stakeholders, corporate annual reports present firm performance and other essential information in narrative, tabular, and graphical formats. Providing useful and unbiased information can be challenging since the underlying accounting information comes from managers and other insiders. Stakeholders must rely on the financial reporting created by managers to evaluate their performance. Data visualization is especially important during this communication process since proper graphs can allow external users to act with knowledge near that of the internal users. On the other hand, improper graphs can leave outsiders misinformed, falsely believing that optimal decisions have been made.

Year reversal refers to the presentation of time-series data in reverse chronological order. While the year order can be reversed in numerous ways, this paper focuses on vertical bar graphs, as most users intuitively and automatically assume the year order to be shown from left to right. More specifically, this research examines how often and why the year orders of vertical bar charts have been reversed in corporate annual reports. The most immediate explanation for year reversal is impression management, or the alteration of data visualization to lead its users with a skewed perspective, especially when their creators have motivations to exaggerate or conceal certain information. Besides, the year order of a bar chart could be reversed because it is presented nearby comparative financial information with a reversed year order. Year reversal can also result from a stylistic choice by the executives in charge of the annual report or the language and culture. All of these reasons must be evaluated to understand the prevalence and plausible explanations of year reversal.

By collecting and examining corporate annual reports, this research answers two essential and inter-related questions. The first question is: how often are the year order of bar graphs in

annual reports presented from right to left? After knowing the prevalence and severity of the unique data visualization design, this research associates the findings with other data sources to answer the second question: what is the reason, if any, that these companies practice year reversal? Although motivation can hardly be proven or disproven, answering the second research question might be tricky yet crucial to providing plausible explanations for year reversals. Individual analysis of each graph will also help determine any possibilities not already identified.

Section II describes the background and research questions in more detail. Section III shows the research methods, data collection and analyses, and processes to ensure coding reliability and data integrity. Analyzing a database of financial graphs from over a decade of annual reports allows an adequate sample of financial graphs to be studied. Research results will be tabulated and presented in Section IV, followed by the conclusions and implications in Section V– not just for the business world but also for other researchers and educators.

II. Background and Research Question

While accounting has the reputation of being an input-based, monotonous activity, its duties and responsibilities as a profession are much broader. Peggy Lane, the Vice Dean of the Wharton MBA program, defined accounting in an interview as "the language of business" in that "it's how businesses communicate about what they're doing to…anybody interested in the performance of the firm" (Lane, 2013). Businesses use accounting to sort their activities in a way that both internal and external users of their data can understand. Despite this, insiders will always have an advantage over outsiders in this way. Working with the data provides an understanding that cannot be replaced. That being said, it can be supplemented with documents like annual reports.

Two documents are referred to as annual reports: a 10-K and a traditional annual report. While both business communications aim to give an accurate image of the company to outsiders and other stakeholders, several differences exist – 10-K reports focus on the financial aspects of firm performance and are filed with the SEC annually. Often thought of as a process of public relations, traditional annual reports provide additional non-financial information, such as environmental, social, and governance (ESG), to supplement 10-K. Therefore, traditional annual reports tend to be flashier and use pictures and data visualization to create a marketable image for shareholders. Traditional 10-K reports were prepared with strict guidelines and contained fewer visual elements. It is a document made mainly for the SEC filing but not for shareholders, though it is not uncommon for a company to stop providing annual reports and add graphs to their 10-K. Analysts prefer 10-K over annual reports for the same reason they favor financial statements. Both emphasize efficient and effective presentation of financial performance. Less-

sophisticated investors prefer annual reports over 10-K for their rich content, broader coverage, and user-friendly designs.

Companies typically utilize annual reports as their major communication between themselves, internal users, and external users (Shen, Lee, & Wang, 2021). The annual report, as defined by John Penrose, has two aspects. He describes that "it contains basic financial information and opinions from management about the prior year's operations and the firm's future prospects" (Penrose, 2008, p. 158). This dual front of fact and opinion helps external users evaluate a company both objectively and through the subjective lens of internal users such as the CEO or CFO. Ideally, this viewpoint represents their actual views on the company and allows stakeholders to see through their eyes.

A survey by WS+B about annual reports is useful for understanding the importance of the annual report. More than 77% of respondents agreed that it is more important than all other corporate publications and nearly 79% agreed that it is vital to investment decisions regarding a company. However, only 33% of respondents claimed to have read most of the document and 39% admitted to reading less than half. For investors particularly, 44% read less than half. This begs the question – if external users value this report so much, why are they barely reading it? The answer to the question may be their time pressure to make decisions, something data visualization can alleviate. Two thirds, or 66%, of respondents preferred annual reports to contain visual illustrations; it was 73% for investors (WithumSmith+Brown, 2006).

Currently, the only data visualization required by SEC is a "performance graph." This is a line chart comparing annual changes in the company's five-year cumulative total shareholder return; it also shows returns for the same period on both a broad equity market index and an industry or peer-group index (Dixon, Corso, Minow, & Goodwin, 1993). Besides, the current

auditing standard AS-2710 classifies data visualization as “other information” and requires auditors to “read the other information and consider whether such information, or the manner of its presentation, is materially inconsistent with information, or the manner of its presentation, appearing in the financial statements.” In other words, as long as the data visualization is not “materially inconsistent” with the financial information, management has discretion on whether or how to visualize their firm performance in corporate annual reports. On the one hand, granting full discretion to management may improve the usefulness of business communications to stakeholders. On the other hand, management may misuse their discretion to manipulate users’ impressions by calibrating or altering the presentation of corporate annual reports.

2.1 Data Visualization

Data visualization is when high quantities of information are summarized into a visual medium, usually a graph, that can be evaluated and understood in a moment. The human mind can understand data and their underlying associations, but it is better suited to the interpretation of senses (Lurie & Mason, 2007). Most of the literature on data visualization notes its “communicative and persuasive roles” (Tractinsky & Meyer, 1999, p. 398) and the prevalence of discussions on its capability in support of choices (Arunachalam, Pei, & Steinbart, 2002).

A single number can be useful to an extent. Knowing a company’s cash balance at a certain time can be useful, but what if you want to know more? Suppose you are less interested in the number now and more focused on the cash trends over time. A list containing a company’s cash balance over seventy years has all the information you need, but you may not be able to appreciate the changes from number to number. However, if this data is plotted in a line graph, it is easier to spot the differences not just from one year to the next but over decades. This is the essence of data visualization.

Graphs, specifically, can be created and presented to convey information, highlight various underlying associations, and tell different "stories" (Shen, Lee, & Wang, 2021). A pie chart shows proportions, a scatter plot shows correlation, and line graphs show the fluctuations of a measure over time. Each type of chart is designed for a specific type of data. Even when presenting the same data, the design and specification of each graph can do better or worse, depending on its style and the nature of the information. In the same way, a person trying to design an informative graph does well to note that there should not be complete creative liberty. "Graphs should be drawn in a manner that leads viewers to reach conclusions consistent with…the underlying numeric data" (Arunachalam, Pei, & Steinbart, 2002) and typically they are, though it is not arduous to do the opposite. Methods for oversaturating a graph with useless details, or "*chartjunk*," are both easy and appealing to presenters (Tractinsky & Meyer, 1999). For instance, the addition of a third dimension to a graph can make it look more attractive than standard two-dimensional ones; however, when more dimensions than variables are added to a graph, the information can be distorted and misleading (Shen, Lee, & Wang, 2021).

It is this misleading information that is particularly concerning to researchers. Shen, Lee, and Wang note that "information encoders must find the best mixture of (graph) elements to help decoders interpret the underlying messages" (Shen, Lee, & Wang, 2021, p. 65). Graph details can enhance the readability of information. They can also "inadvertently lead users to stare at a graph but never understand the underlying messages or, even worse, draw misleading or inaccurate conclusions" (Shen, Lee, & Wang, 2021). This is the hidden difficulty of using graphs. To condense and convey information, one cannot simply thrust data into a graphing tool nor can they add whatever detail they want. Data visualization must be simple yet informative, or

else it will be useless (Tractinsky & Meyer, 1999). So far, these explanations assume that the creation or presentation of misleading information is unintentional. This is not always the case.

2.2 Impression Management

The practice of taking something with a clear conclusion at its center and twisting it such that one will come to a different, typically more positive, one is called impression management (Arunachalam, Pei, & Steinbart, 2002). A simple example of impression management could be wearing a suit and tie to seem more professional. The person still has the same knowledge and ability, but they may be perceived as having more because they are wearing clothes associated with professionalism. Impression management is typically used to describe more data-driven manipulation. As illustrated in Figure 1, the 2008-2010 capital expenditures of Comcast Corporation were presented in a combo chart. While the underlying data is no different when presented with additional depth, the third dimension might make the users "feel" more confident in the firm's performance. To extend the metaphor, the creator of Figure 1 has dressed the data in better clothing to make the trend seem more favorable.

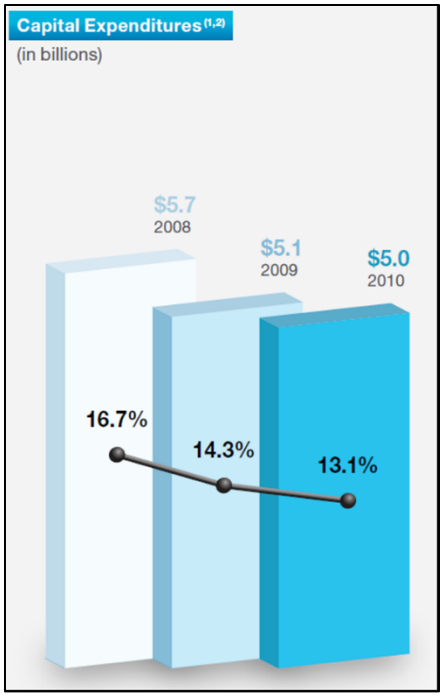


Figure 1: Graph from the Comcast Corporation Annual Report in 2010

The ethics of impression management continue to be debated. Those in favor consider it normal and acceptable, as most people try to leave a good impression in their daily lives whenever they are given a chance. If there is nothing morally wrong with trying to appear as good as possible, why would it be wrong to do the same thing when presenting firm performance to stakeholders? Supporters also cite that impression management does not contain any falsehoods. All the necessary data is present; it is simply arranged to tell

a story or enhance the information. Not to mention creators of data visualization cannot envision or prevent any potential misunderstanding from happening. Users shall be responsible for failing to interpret the data visualizations properly.

Those against impression management believe that this is an overgeneralization of what is, by definition, deception. “Deceive” is defined by the Oxford English Dictionary as “to cause to believe what is false; to mislead as to a matter of fact, lead into error, impose upon, delude, ‘take in’” (Simpson, Weiner, & Oxford University Press, 1989) and quite different from simply trying to look good. A person wearing a suit is trying to appear more professional, but this is usually because they indeed are and they want to emphasize their qualifications. Impression management is the emphasis of a false conclusion. Although impression management is generally not considered lying, it may lead someone to do something harmful to themselves.

There is psychological evidence to support opinions opposed to impression management. People tend to take the path of least resistance when studying data, choosing the options that allow fast and easy decisions (Arunachalam, Pei, & Steinbart, 2002). Graphs serve as this path, allowing a person to evaluate financial data quickly. Thus, if a person is given both raw data and a processed data visualization incorrectly summarizing it, they will typically be biased toward the graph (Chang & Luo, 2019). Even a graph with numbers shows this; the reader may only skim data and focus on the picture. People also have issues with detecting small changes to an image (Arunachalam, Pei, & Steinbart, 2002) and tend to both fail to notice a small error as well as rely on it.

The methods of impression management are varied. Arunachalam et al. noted, among other examples, that distorting proportionality to exaggerate a trend, masking a trend by graphing it with another, omitting negative numbers, and the reversal of year order were popular methods

of distorting bar graphs (Arunachalam, Pei, & Steinbart, 2002). Three-dimensional graphs, like Figure 1, are a type of proportionality distortion – the extra dimension makes it harder for users to visually judge the changes over time, while the superfluous top artificially exaggerates the trend. A company can also omit negative numbers from a graph to "clean" it, but there is no critical reason aside from hiding the numbers in the same way that no functional purpose exists for adding the third dimension. This is presumptuous, of course, but it is reasonable to assume that if something is hidden or altered, it is because the person who interfered does not want it to be found. Negative numbers also tend to be less favorable than positive ones in a corporate setting, giving clear motive, means, and opportunity for their concealment. Arunachalam et al. documented the year reversal phenomenon and examined its impact on decision making, but no empirical evidence on its prevalence and severity was provided.

2.3 Year Reversal

Like all other impression management tricks, year reversal might be viewed as a "sneaky" practice when presenting firm performance. At first glance, Figure 2 shows a positive trend if its users assume its year order from left to right. However, its chronological order has been reversed by displaying the most recent year first and continuing backward. Anyone who studied the graph can see this plainly, and yet even reasonably informed users can be affected by such a practice, especially when under time pressure (Arunachalam, Pei, & Steinbart, 2002).

Figure 2: Graph from the Johnson & Johnson Annual Report in 2018

Financial reporting should provide a correct image of what it communicates. The unfortunate truth is that many companies only abide by this purpose to the extent that it is convenient. Their goal, instead, may be conveying a favorable image rather than the correct one. Calling it lying is easy but not always true. Everything in an annual report can be true and still leave a reader with the wrong impression, and this is not always the fault of impression management. Year reversal has a few potential reasons.

2.4 Plausible Explanations of Year-Reversal

2.4.1 Natural Language

The company of origin could potentially affect year order[1]. English speakers may find it easy to assume that script should always be read from left to right. However, not all languages are read this way. Some languages, such as Arabic and Hebrew, are read from right to left. Others, like traditional Chinese, can be read in either direction. These cases are rare but still a plausible reason that was discussed in the research process. Acknowledging this is also the first step in studying year reversal. It is symbolic of how even the most basic assumptions, such as the direction of language or the likelihood of impression management, must be studied on their own and never assumed.

2.4.2 Proximity to a Comparative Financial Statement

In the U.S., multi-year comparative financial statements present data of the current year next to their account titles, so as to highlight the most relevant information ahead of something less so from the past. Time-series data in tables is traditionally in reversed chronological order for this reason, contrasting financial graphs which typically depict year order from left to right.

[1] This research only collects and analyzes graphs from the annual reports of companies reporting in the United States of America. Some graphs from East Asian and West Asian companies were checked, but not with the main data analysis.

When a company plans to illustrate tabular time-series information by using graphs, an inevitable dilemma occurs – should the graphs be reversed to match the tables? Reversing the year order in bar charts can avoid inconsistency between the tabular and graphical presentation of the same data. Unfortunately, doing this deviates from users' graph analysis habits. Not doing it can still confuse them; it asks users to notice the very details of which Arunachalam et al. warned. This is especially the case when tabular and graphical presentations are close to each other.

2.4.3 CEO or CFO Turnover

The Sarbanes-Oxley Act requires that the CEO and CFO be specifically responsible for the faithful representation of the information in annual reports. Since they are typically the ones to approve the final presentation of firm performance, a connection was possible. The CEO or CFO may request or accept reversed graphs as a stylistic choice. It could also be tied to impression management or the proximity between the tabular and graphical presentation of the same information. While the reasons could be hard to discern, the occurrence can still be studied objectively.

2.4.4 Firm Performance

Firm performance could be another plausible explanation of year reversal. Specifically, a company with unfavorable financial trends might be uncomfortable visualizing them in their annual reports. Reversing the year order may help conceal or beautify these trends. Though recent accounting scandals have made governments sensitive to dishonesty in official corporate documentation, impression management tends to avoid this scrutiny. It can hide unfavorable data without actually lying. It is for this reason that a poor performing company may be correlated to an adoption of year reversal, and it is this exact correlation that will be investigated.

2.4.5 Research Questions

To summarize, this research posits two questions. First, how often are the year order of bar graphs in annual reports presented from right to left? This question is essential for two reasons. First, the frequency of year reversal shows the prevalence and severity of the potential confusion and misunderstanding. Second, the occurrence of year reversal serves as the foundation for studying other factors, such as impression management.

Once the first research question is answered, it presents the second: what are the reasons, if any, that these companies practice year reversal? While the discussed reasons may be present, there is also the possibility that something not previously predicted has occurred. Also, there is a chance that the year reversal was purely unintentional with no particular cause at all. Finding potential causes will be critical in determining the severity of the year reversal phenomenon, as well as yielding implications to users, educators, and policy-makers.

III. Research Methods

3.1 Data Collection

This research explores the prevalence and severity of year reversal by using data from a private database assembled and built by Dr. Milton Shen of the University of Alabama in Huntsville. The database collects the 2004-2019 annual reports of the Fortune 100 companies on the 2010 list. The database also stores all types of graphs from those annual reports and their graphing attributes (e.g., format, 2D/3D). To examine the associations between year reversal and other factors, this research also manually gathers firm performance and CEO or CFO turnover data from annual reports.

Note that the data collection somewhat limits the scope of this research. Specifically, none of the 2010 Fortune 100 companies are originated from or headquartered in regions whose natural language is written from right to left. While it is tempting to provide a universal or multi-national explanation to year reversal, this research can only explore, investigate, and conclude based on available data – all from English-speaking countries. In other words, one of the plausible explanations, natural language, cannot be examined by this research and requires additional collection in future research.

3.2 Coding Process and Inter-Rater Reliability (IRR)

Whenever the data collection required subjective judgment, two independent coders worked separately to ensure consistency and reliability. Their coding results were recorded and then compared automatically by the cloud database. Any inconsistency was flagged by the system and awaited further manual reconciliation. By doing so, inter-rate reliability could be computed and data analyses was performed on agreed-upon coding results, allowing conclusions to be asserted based on scientifically examined datasets.

3.3 Data Analyses

Data visualization allows people both familiar and unfamiliar with the information to see trends and expedite decision making. Most prior research focuses on the strength and benefits of data visualizations but rarely notices their potential drawbacks, especially when they are created to manage impressions. Due to the scarcity of prior studies, this paper is put in a unique position as an exploratory study, where no specific hypothesis testing will be proposed or performed. It would be bold to try and end a discussion in the same work that started it. Even if this were not an early study, the number of bar graphs with reversed years was not high enough to merit formal statistical testing. Instead, descriptive statistics will be used which allow a degree of perspective surrounding the year reversals, describing the situation that could prompt a reversal without making a definitive claim.

IV. Research Results

4.1 The Prevalence of Year-Reversal

The aforementioned private database collects 11,840 financial graphs including bar, line, pie, and other charts from 2004 to 2019. The two raters sorted through these graphs, separated them into their related graph categories, and then classified bar charts based on their format (i.e., vertical/horizontal) and presentation. As measurements of inter-rater reliability, all Cohen's Kappa scores for the coding processes are greater than .90, higher than the threshold of acceptance.

The bar charts were extracted from this group, and they numbered 8,188 according to Table 1. It also shows that 7,167 of these graphs were vertical, giving us our sample. An interesting note is that bar charts represented 69.2% of the total sample and 60.5% were vertical bar charts. This alludes to the importance of this study. Three-fifths of the sample population applied to what was researched, a notable amount.

Year	Horizontal	Vertical	Total
2004	68	453	521
2005	32	521	553
2006	63	512	575
2007	39	498	537
2008	61	428	489
2009	93	365	458
2010	69	351	420
2011	77	442	519
2012	93	393	486
2013	67	442	509
2014	84	506	590
2015	53	533	586
2016	47	460	507
2017	60	518	578
2018	52	408	460
2019	63	337	400
Total	1021	7167	8188

Table 1: Horizontal vs. Vertical Bar Graphs

Year	Reversed	Standard	Total
2004	17	409	426
2005	9	481	490
2006	9	471	480
2007	7	446	453
2008	10	377	387
2009	8	329	337
2010	1	329	330
2011	1	406	407
2012	26	341	367
2013	46	363	409
2014	47	409	456
2015	39	451	490
2016	84	329	413
2017	77	399	476
2018	56	316	372
2019	54	253	307
Total	491	6109	6600

Table 2: Reversed vs. Standard Vertical Bar Graphs

The next step was to divide these vertical bar charts into those with standard and reverse year order. As shown in Table 2, among all 7,167 vertical bar charts, 6,600 depict time-series data – 6,109 (92.6%) with standard year order from left to right and 491 (7.4%) with reversed year order from right to left. Although deciding a cutoff for the prevalence of a phenomenon is inevitably subjective and arbitrary, it shall be troubling for most people to learn that more than one in twenty vertical bar charts were presented with reversed year order.

Table 3 shows the count of year-reversal graphs by firm year to further examine the pervasiveness and severity. During 2004-2019, 18 companies provided at least one vertical time-series bar chart. While year reversal seemed incidental to some companies (e.g., ConocoPhilips and Liberty Mutual), many other companies reversed their year-order for several consecutive years and multiple times per year, suggesting that the decision to reverse the year order may not have been random or unintentional. The American International Group and Hartford Financial

Company	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Allstate														3	3	3	9
American International Group									25	37	31	31	38	39	38	38	277
ConocoPhillips											9						9
Enterprise Product Partners	8																8
General Motors	4	4	4														12
Hartford Financial Services													33	28			61
Home Depot															1	1	2
Intel					2	1	1	1	1	1	1	1	1	1			11
Johnson & Johnson															4	4	8
Liberty Mutual Insurance Group										2							2
Lockheed Martin	3	5	5	4	5	5											27
Merck				3	3	2											8
MetLife													4	4	4	2	14
Northrop Grumman										6	6	6	6				24
Pfizer												1	1	1			3
Target													1	1	1	1	4
Tyson Foods	2																2
Verizon Communications															5	5	10
Total	**17**	**9**	**9**	**7**	**10**	**8**	**1**	**1**	**26**	**46**	**47**	**39**	**84**	**77**	**56**	**54**	**491**

Table 3: Breakdown of Vertical Bar Graph Year Reversals by Company and Year

Services provided more vertical bar charts with year reversal, respectively representing 56.4% and 12.4% of the total count.

In sum, based on the descriptive statistics presented above, the year reversal of vertical bar charts seems prevalent or unignorable, either in terms of graph counts (7.4%), firm counts (18%), or firm-year-level. The recurring nature of most examples suggests plausible causes other than unintentional errors or happenstance. The year order of those vertical bar charts might be calibrated to convey information under certain circumstances.

4.2 Proximity

Financial graphs are frequently used to illustrate or supplement the tabular presentation of information. The process to examine the impact of proximity started with tracing all graphs with reversed year order to their annual report of origin. As shown in Table 4, if the graph appeared on the same page as a related table with reversed year-order, it was marked in the "Same Page"

	Total	Same Page	Same or +1	% Same Page	% Same or +1
Allstate	9	0	3	0.0%	33.3%
American International Group	277	71	209	25.6%	75.5%
ConocoPhillips	9	0	9	0.0%	100.0%
Enterprise Product Partners	8	0	0	0.0%	0.0%
General Motors	12	12	12	100.0%	100.0%
Hartford Financial Services	61	15	56	24.6%	91.8%
Home Depot	2	0	2	0.0%	100.0%
Intel	11	9	11	81.8%	100.0%
Johnson & Johnson	8	8	8	100.0%	100.0%
Liberty Mutual Insurance Group	2	0	0	0.0%	0.0%
Lockheed Martin	27	7	13	25.9%	48.1%
Merck	8	0	8	0.0%	100.0%
MetLife	14	0	0	0.0%	0.0%
Northrop Grumman	24	0	0	0.0%	0.0%
Pfizer	3	0	3	0.0%	100.0%
Target	4	0	2	0.0%	50.0%
Tyson Foods	2	0	2	0.0%	100.0%
Verizon Communications	10	0	10	0.0%	100.0%
All	491	122	348	24.8%	70.9%

Table 4: Proximity of a Table to Reversed Bar Graphs

column. If there was a similar table on the page before or after the graph, it was marked in the "+1" column.

In 24.8% of vertical bar charts, the year order appeared on the same page as a related comparative table, whereas 70.9% of the reversed graphs were on the same page or within one page of a related table. Table 4 also shows that nine companies, or half of those in the reversal group, had all of their graphs in proximity and only four had none in proximity.

The companies with 100% proximity are self-explanatory. Tyson Foods, for instance, showed strong signs that their two graphs were specifically made to emphasize tables. The 0% cases were slightly more nuanced. Liberty Mutual Insurance Group's graphs were an example with nothing in the vicinity, aside from the text itself, correlated to the graphs or explaining why their year orders were reversed. Of the companies in neither of these categories, only two with neither a 100% or 0% value had less than half their graphs in proximity, Allstate and Lockheed Martin. Lockheed Martin was determined to be a likely candidate for proximity despite this. The analysis of the tables showed that all the graphs in their annual reports belonged to a specific section that was filled with tables that referenced them repeatedly. With this in mind, the total number of companies showing evidence of reversing their year orders due to table proximity came to thirteen, or 72.2%. This final number and the companies they represent will be studied further in Section 4.5.

4.3 CEO or CFO Turnover

To examine the potential impact of CEO or CFO turnover on year reversal, this research checked corporate annual reports to determine if a new CEO or CFO was appointed in the first year of year reversal. While correlation is not causation, this is the closest available evidence without personally interviewing the company executives. The results of this analysis are

summarized in Table 5. Eight (44.4%) of the companies with year reversal had a new CEO or CFO in the first year of reversal, including two (11.1%) new CEO and six (33.3%) new CFO.

It should be noted that the current cloud database collects and stores annual reports from 2004 to 2019, but some year reversals first took place before 2004 (e.g., Lockheed Martin in 2000). An interesting case with CEO turnover was Enterprise Product Partners whose year reversal started in the year when a new CEO was appointed and then ended when this CEO departed. This made the likelihood of their CEO being related to the year reversal of their bar charts more probable.

Although corporate executives are not the creators of annual reports, they are responsible for the faithful representation of financial reporting and thus have to approve its content and presentation. The 44.4% correlation suggests an association or a plausible explanation for year reversal.

	New CEO	New CFO
Allstate		X
Enterprise Product Partners	X	
Johnson & Johnson		X
Lockheed Martin		X
Merck		X
Target		X
Tyson		X
Verizon Communications	X	

Table 5: New CEO/CFO in First Year of Reversal

4.4 Firm Performance

The impact of firm performance on year reversal was examined at two levels – firm-year and individual graph. An analysis was done similar to that for CEOs and CFOs. Instead of executives, this one checked the net income and the EPS of the company being studied in the first year of year reversal. This year was noted and compared to the previous one. The change of these financial measures between the first year of reversal and the one before was measured. The

results of this are in Table 6. Two companies, General Motors and Lockheed Martin, had their first year of reversal outside the sample time period; both are starred in the "First Reversal" column.

		NI (in Millions)			EPS		
Company	First Reversal	Previous Year	Reversal Year	Change	Previous Year	Reversal Year	Change
Allstate	2017	$ 1,877.00	$ 3,189.00	$ 1,312.00	$ 4.72	$ 8.49	$ 3.77
American International Group	2012	$ 17,798.00	$ 3,438.00	$ (14,360.00)	$ 9.44	$ 2.04	$ (7.40)
ConocoPhillips	2014	$ 9,156.00	$ 6,869.00	$ (2,287.00)	$ 7.43	$ 5.54	$ (1.89)
Enterprise Product Partners	2004	$ 105.00	$ 268.00	$ 163.00	$ 0.42	$ 1.01	$ 0.59
General Motors	2002*	$ 1,736.00	$ 4,063.00	$ 2,327.00	$ 3.37	$ 7.24	$ 3.87
Hartford Financial Services	2016	$ 1,682.00	$ 896.00	$ (786.00)	$ 4.05	$ 2.31	$ (1.74)
Home Depot	2018	$ 8,630.00	$ 11,121.00	$ 2,491.00	$ 7.33	$ 9.78	$ 2.45
Intel	2008	$ 6,976.00	$ 5,292.00	$ (1,684.00)	$ 1.20	$ 0.93	$ (0.27)
Johnson & Johnson	2018	$ 1,300.00	$ 15,297.00	$ 13,997.00	$ 0.48	$ 5.70	$ 5.22
Liberty Mutual Insurance Group	2013	$ 829.00	$ 1,743.00	$ 914.00	N/A	N/A	N/A
Lockheed Martin	2000*	$ 382.00	$ (519.00)	$ (901.00)	$ 0.99	$ (1.29)	$ (2.28)
Merck	2007	$ 4,434.00	$ 3,275.00	$ (1,158.00)	$ 2.04	$ 1.51	$ (0.53)
MetLife	2016	$ 5,310.00	$ 800.00	$ (4,510.00)	$ 4.61	$ 0.63	$ (3.98)
Northrop Grumman	2013	$ 1,978.00	$ 1,952.00	$ (26.00)	$ 7.96	$ 8.50	$ 0.54
Pfizer	2015	$ 9,136.00	$ 6,960.00	$ (2,176.00)	$ 1.44	$ 1.13	$ (0.31)
Target	2016	$ 3,363.00	$ 2,737.00	$ (626.00)	$ 5.35	$ 4.74	$ (0.61)
Tyson Foods	2004	$ 337.00	$ 403.00	$ 66.00	$ 0.98	$ 1.17	$ 0.19
Verizon Communications	2018	$ 30,101.00	$ 15,528.00	$ (14,573.00)	$ 7.37	$ 3.76	$ (3.61)

Table 6: Net Income and EPS Trends in Year Reversal

This preliminary analysis of favorability showed that eleven out of eighteen, or 61.1%, of the companies with reversed bar charts had either a decrease in net income or EPS in their first year of reversal. This means that they were likely to have poor overall performance and a motivation to use impression management. This list did not change much between the two variables. Northrop Grumman was the only company with just one of the two variables showing a decrease.

There are two specific cases of note. The first is Hartford Financial Services whose year reversal in 2016 and 2017 clearly illustrates the association between firm performance and graphing policy. As shown in Figure 3, Hartford showed consistent increases in net income during 2013-2015 where all bar charts were presented in standard year order. However, when

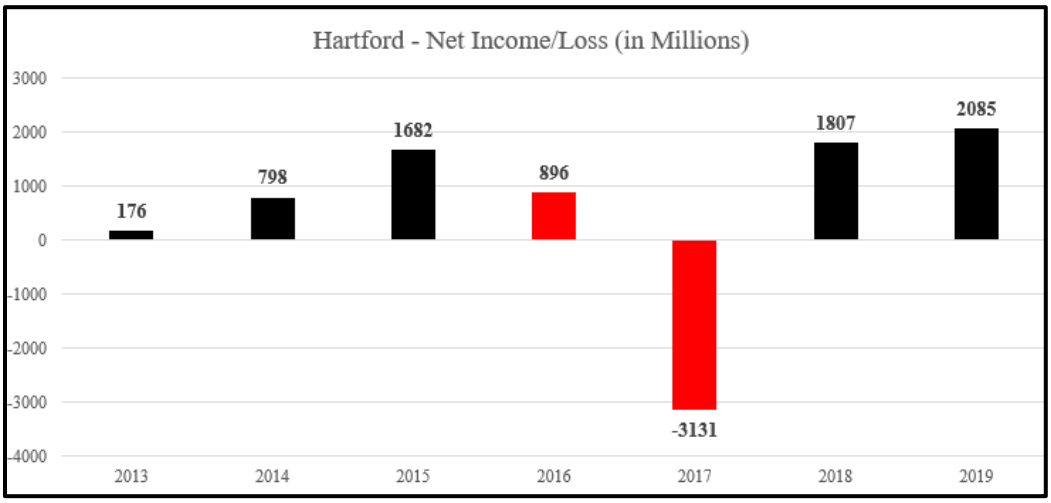


Figure 3: Net Income Trends for Hartford Financial Services

income declined in 2016 and turned negative in 2017, year reversal occurred in their annual reports as seen in Table 3. When Hartford observed increases in firm performance in 2018 and 2019, all year orders were presented from left to right again.

The other case is ConocoPhillips. Their behavior surrounding their year reversals could be interpreted as examples of the various means for covering negative trends. Some information related to this case is presented in Table 7. In 2011, ConocoPhillips had a favorable performance, particularly an increase in net income. The bar graphs were presented vertically with a standard year order to highlight its success. Their net income declined in 2012 by 32% to $8.4 million. Suddenly, the previously vertical graphs became horizontal, probably because changes in horizontal bar charts tend to be less visible or prominent. This decision continued through 2013 with a slight recovery in net income. In 2014, ConocoPhillips experienced another sharp decline in net income. The horizontal bar graphs were presented vertically again, but this time with

Year	Net Income (in Millions)	Changes in Net Income	Bar Charts
2011	$ 12,436.00	$ 1,078.00	Vertical, Correct
2012	$ 8,428.00	$ (4,008.00)	Horizontal
2013	$ 9,156.00	$ 728.00	Horizontal
2014	$ 6,869.00	$ (2,287.00)	Vertical, Reversed
2015	$ (4,428.00)	$ (11,297.00)	No bar chart

Table 7: Net Income Trends for ConocoPhillips

reverse year order. Their net income declined sharply again in 2015, resulting in a net loss of $4.4 million. In this year, no chronological bar graph was presented in its annual reports. ConocoPhillips demonstrates multiple changes that could be impression management: a shift from vertical to horizontal, reversal of year order, and the removal of a graph. Each coincided with a decrease in net income.

While the examples and the analysis in Table 6 were enlightening, the impact of firm performance on year reversal was also examined at the individual graph level. The graphs were first traced to their annual reports of origin, like with table proximity. This time, they were checked for the underlying content favorability. The next step in some cases was to also check the favorability of the graphs in the proximity of the reversed ones. Whether or not they were reversed could be relevant in determining a pattern. One part of the impression management assertion is that, in order to cover the reversal of one unfavorable graph, a company will reverse all the graphs on that page or in proximity of it.

	Graphs	Pages	Negative Graphs	% Negative Graphs	Negative Pages	% Negative Pages
Allstate	9	3	3	33.3%	2	66.7%
ConocoPhillips	9	1	4	44.4%	1	100.0%
Enterprise Product Partners	8	4	0	0.0%	0	0.0%
General Motors	12	3	9	75.0%	2	66.7%
Hartford Financial Services	61	31	29	47.5%	19	61.3%
Home Depot	2	2	0	0.0%	0	0.0%
Intel	11	10	6	54.5%	5	50.0%
Johnson & Johnson	8	4	2	25.0%	2	50.0%
Liberty Mutual Insurance Group	2	1	0	0.0%	0	0.0%
Lockheed Martin	27	27	3	11.1%	3	11.1%
Merck	8	3	2	25.0%	2	66.7%
MetLife	14	7	6	42.9%	3	42.9%
Northrop Grumman	24	4	11	45.8%	3	75.0%
Pfizer	3	3	1	33.3%	1	33.3%
Target	4	4	4	100.0%	4	100.0%
Tyson Foods	2	1	1	50.0%	1	100.0%
Verizon Communications	10	2	3	30.0%	2	100.0%
Total	214	110	84	39.3%	50	45.5%

Table 8: Table Proximity Analysis for Bar Chart Year Reversal

For this reason, favorability was considered in terms of graphs and pages for all companies, excluding the outliers. A page was considered unfavorable if even one graph present was this way. The results of these more subjective analyses are summarized in Table 8.

One matter to discuss is the American International Group (AIG). They were excluded from this favorability analysis since the unfavorability of their graphs was already apparent. There was a major accounting scandal in 2005 that seriously affected AIG during the sample period making it qualitatively distinct from other samples. They have been studied extensively in past papers and analyses and their reasons for covering unfavorability were obvious.

Table 8 shows the results of graph-level favorability analyses without AIG. In 39.3% of the vertical bar graphs with year reversal, there was a level of unfavorability. When measured by page, this ratio increased to 45.5%. Only four out of eighteen (22.2%) of the companies in the year reversal group had 50% or more of their reversed bar charts displaying unfavorable trends. Eleven out of eighteen, however, had half or more of their pages showing at least one negative graph. The increase from 22.2% to 61.1% is notable. The latter percent is also identical to the percent of companies displaying negative firm performance in Table 6 though the companies themselves were different in each table.

4.5 Summary

After examining several plausible explanations, the results are summarized in Table 9. A mark in any column means that there is evidence for the reason mentioned in the heading. The "Unfavorable (Graph and Page)" column pertains to Table 8 and the companies are marked if 50% or more of their pages were negative. The "Unfavorable (Year of Reversal)" column is for Table 6, and companies were tagged if they had either a decrease in net income or EPS in the first year that their bar charts displayed reversed year order. The "New CEO/CFO" column is connected to Table 5 and companies are marked if their CEO or CFO was new at the beginning or end of their reversals. Finally, the "Table Proximity" column describes Table 4 and companies are considered to have evidence if 50% or more of their graphs were on the same page or within one page of a table of financial statements.

The only two cases deviating from this treatment are American International Group and Lockheed Martin. The former is marked under "Unfavorable (Graph and Page)" despite not

	Unfavorable (Graph and Page)	Unfavorable (Year of Reversal)	New CEO/CFO	Table Proximity	Explained
Allstate	X		X		X
American International Group	X	X		X	X
ConocoPhillips	X	X		X	X
Enterprise Product Partners			X		X
General Motors	X			X	X
Hartford Financial Services	X	X		X	X
Home Depot				X	X
Intel	X	X		X	X
Johnson & Johnson	X		X	X	X
Liberty Mutual Insurance Group					
Lockheed Martin		X	X	X	X
Merck	X	X	X	X	X
MetLife		X			X
Northrop Grumman	X	X			X
Pfizer		X		X	X
Target	X	X	X	X	X
Tyson Foods	X		X	X	X
Verizon Communications	X	X	X	X	X
Total	12 of 18	11 of 18	8 of 18	13 of 18	17 of 18

Table 9: Consolidation of All Previous Analyses

being studied in this analysis because of the clear unfavorability described in section 4.4. Lockheed Martin is marked under the "Table Proximity" column even though its percent is less than half since it showed clear signs of table proximity despite this. It should also be stressed that evidence of one of these reasons does not mean that it is true. There is only the potential for it to be true. The final column in Table 9 is marked "Explained," not because it is definitive but because it is a possibility. Thus, Table 9 should be thought of as simply a tabulation of potential causes.

The results of this final analysis were telling. Of the eighteen companies, only one, Liberty Mutual Insurance Group, had year reversals with no explanatory evidence. This was greater evidence than what was anticipated. These three reasons were merely suggested as possibilities during the early stages of research. It was unknown that they would play such a large role. Seventeen out of eighteen companies, or 94.4%, displayed evidence for being explained by these three reasons. Fifteen out of eighteen companies had evidence for either method of unfavorability, and eight, or 44.4%, had both types of evidence. Eleven of the eighteen companies, or 61.1%, had either type of unfavorability evidence and table proximity evidence. Three of the eighteen, 16.7%, had all four types of evidence gathered. Even though none of this evidence indicates a certainty, it is promising to see that only one company did not present data corroborating one of the three reasons.

The above percentages could also indicate a connection between reasons. It is possible that a company with negative firm performance may try to explain their unfavorability with tables while also trying to disguise their trends. The 61.1% showing unfavorability and proximity serve as evidence of this. It could also be that a new CEO or CFO prefers using more tables and therefore led to year reversal. Six of the eighteen companies, or 33.3%, had both a new executive

and table proximity lending evidence to this possibility. There are many connections that could be drawn, and each one has the potential to be its own research paper. That is why it is important for this research to continue.

V. Conclusion

5.1 Methodology

When this research project was initiated, the hope was that some level of correlation could be found between any reason for the year reversal of bar graphs and the data itself. Even a 33% correlation would have been considered a success. Instead, strong correlations to both firm performance and table proximity were found, many times with the same company. The ultimate result of this research is a methodology for explaining year reversal. Whenever a company's annual report has a bar chart in reverse chronological order, the first thing to check is whether the data it displays shows a positive or negative trend. Next, the surrounding graphs should be examined for this and the surrounding tables for reverse year order. The CEO and CFO of the company should also be noted to see if a new one appeared in the first instance of reversal. If the findings of this paper are correct, this should provide the cause more than nine out of ten times.

5.2 Implications

Three-fifths of the companies reversing their year orders had half or more of these graphs showing or in the proximity of an unfavorable trend. Although correlation does not equal causation, this percent seems too large to ignore. It is noteworthy that 7.5% of all vertical bar graphs with time-series data observed showed reverse year order. The table proximity correlation shows there is a chance that these reversals are innocent. However, it is just as likely that it is tied to impression management.

Many professions involved in business, such as accounting, are founded on tenants of fair presentation. It is good, for this reason, to avoid any practice that is or could be misconstrued as deception. For this reason, it is recommended that year reversal be avoided or explicitly marked when visualizing time-series data.

Impression management is more than just year reversal, but many tricks or gimmicks have yet to be studied. Future researchers are encouraged to investigate other forms of impression management by adopting a similar research method. Also, the exploratory nature of such investigations cannot be emphasized enough, as some causes may very well be innocent while other plausible causes could be identified during data collection or processing. This research particularly has no intent to provide a universal explanation for year reversal. The impact of natural language on the presentation of year order, for instance, is still an open question.

Implications for educators can also be formed from the data gathered. While impression management and other confusions in corporate reporting cannot be stopped, there are ways against which they can be defended. The best way to do this is by teaching students how to watch for and interpret unusual forms of data visualization. It brings to mind the methods used by anti-counterfeiting agents in the government. To spot counterfeit money, they do not try to learn every possible method of forgery nor every discrepancy that fake money can have. Instead, they memorize the details of real money to such a degree that any peculiarities stand out immediately. From here, an agent can research the methods used to create the counterfeit bill.

The same approach should be used when teaching students to spot impression management. There is nothing wrong with showing the already discovered methods, but the most important thing to teach is what good graphs look like. Students should be constantly reminded of the proper techniques and presentation of visual data. That way, when something violates these rules, the students will be able to spot it. There are many readily available papers and studies that can be consulted when impression management is found. Better than this, the student in question could perform their own research and add to the academic works. However, it all

depends on the ability to find it in the first place, and this is something that usually must be taught.

Despite these statements on impression management, it is essential to reiterate that there was equal evidence that year reversal is innocent. Whether or not this is true, one thing is sure – a reversed year order can confuse and harm the user of the data. There are few situations where having the wrong information can be beneficial. To remain fair, year reversal of vertical bar graphs should be avoided or clearly marked. Any benefits are irrelevant in light of the harm it can cause. As for the users, they should not only keep in mind that year reversal could exist, but that all data should be studied closely before being used. No corporate information should be taken at face value. As has been evidenced in this paper, it often says the opposite of its first impression.

VI. Bibliography

Arunachalam, V., Pei, B. K., & Steinbart, P. J. (2002). Impression Management with Graphs: Effects on Choices. *Journal of Information Systems, Volume 16*(Issue 3), 183-202.

Chang, C. J., & Luo, Y. (2019). Data Visualization and Cognitive Bias in Audits. *Managerial Auditing Journal*.

Dixon, C. T., Corso, G. W., Minow, N., & Goodwin, B. S. (1993). Executive Compensation in the Spotlight. *Financial Executive; Morristown, Volume 9*(Issue 1), 19.

Lane, P. B. (2013, September 23). Peggy Bishop Lane on Why Accounting Is the Language of Business. (K. @. School, Interviewer)

Lurie, N. H., & Mason, C. H. (2007, January). Visual Representation: Implications for Decision Making. *Journal of Marketing, Volume 71*(Issue 1), 160-177.

Penrose, J. M. (2008, April). Literature on Annual Report Graphic Use. *Journal of Business Communication, Volume 45*(Issue 2), 158-180.

Shen, W.-C. M., Lee, C.-C., & Wang, T.-W. (2021, February). Potential Bias in Creative Chart Design: A Review of Nontraditional Financial Graphs in Corporate Annual Reports. *Associations for Computing Machinery*, pp. 59-65.

Simpson, J. A., Weiner, E. S. C., & Oxford University Press. (1989). The Oxford English Dictionary. Oxford: Clarendon Press.

Tractinsky, N., & Meyer, J. (1999, September). Chartjunk or Goldgraph? Effects of Presentation Objectives and Content Desirability on Information Presentation. *MIS Quarterly, Volume 23*(Issue 3), 397-420.

WithumSmith+Brown. (2006). Annual Report Survey & Findings. MGT Design Inc.