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Final Report: Exploring Company Earnings Calls Before and After COVID-19

Introduction

In this project, I investigated the evolution of discourse by business leadership teams before and after the COVID-19 pandemic. To this end, I analyzed 4,215 quarterly earnings call transcripts produced by 353 different companies across 11 different industries. Due to a limited sample size of available documents prior to 2018, only transcripts between 2018 and 2022 were investigated, and only companies that produced earnings calls in 2022/possessed at least one years' worth of earnings calls were considered.[1]

I initially hypothesized that inter-company call terminology would follow a cyclical pattern across quarters (e.g. rising at year's end to rally shareholders), that COVID-19 terms would be highly significant within the corpus of earnings calls, and that firm "fear" sentiments would follow a similar pattern of spiking in 2020 due to the pandemic's onset.

In the following two sections, I will detail the methods used to investigate these hypotheses while drawing out several key insights, concluding with a discussion of limitations and future investigation opportunities.

Insights

Earnings Call Discourse Patterns

After generating a bag-of-words (BOW) table for the corpus at an "earnings_id" level, I inspected document significance and term significance within the corpus. Document significance did not appear linked to either the industry ("sector") or quarter of earnings calls, but term significance did exhibit several patterns across by-year VOCAB tables. For instance, the words "traditional," "active," and "economic" appeared in the top-ten most significant adjectives for at least three of the five years available (Figure 1).

The significance of "traditional" is particularly interesting to me, since it may reflect conservative or reflective posturing of company officials within earnings calls. Indeed, when searching for the top-ten most similar words from an embedding standpoint (using Word2vec), "traditional" was matched with "conventional," "legacy," "linear," and "classic." Although this observation cannot be causally linked to a lack of innovation within modern businesses, it may suggest a tendency for company leadership to utilize conservative language as a means to assure shareholders of continued company performance.

[1] For a more thorough description of how earnings calls are structured and their purpose in the business world, please see "ETA_Manifest Document_04MAY2022".

	2018	2019	2020	2021	2022
0	efficient	limited	traditional	efficient	internal
1	dynamic	true	sequential	late	smaller
2	active	economic	huge	traditional	primary
3	proud	detailed	sustainable	summary	live
4	consolidated	profitable	local	closer	super
5	internal	interesting	primary	comfortable	efficient
6	traditional	tremendous	integrated	multi	optimistic
7	economic	highest	appropriate	active	late
8	live	challenging	multi	local	true
9	attractive	sustainable	optimistic	primary	active

Figure 1: *Top-ten terms by DFIDF within the VOCAB tables for each year*

Semantic algebra conducted via word embeddings also revealed insights about the deeper relationships and associations between words used in the business world. For instance, an analogy query for *failure:success :: bankruptcy:?* accurately suggested that "acquisitions," "momentum," and "traction" were the counterparts of financial default. Similarly, the acronyms "WACC" (weighted average cost of capital) and "ROI" (return on investment) – both crucial, yet elusive figures used to assess the market capitalization of a company – were accurately paired with "11[%]" (the estimated average cost of capital for most firms) and "value," respectively. While these relationships might be unsurprising to financial analysts, they reveal terminology associations to non-business audiences that aren't patently obvious.

Finally, although earnings call discourse did not display textual patterns across quarters, hierarchical clustering and principal component analysis (PCA) of earnings calls suggested that earnings calls of industry peers are highly similar. The cosine-similarity dendrogram displayed in Figure 2 reveals that a random sample of 20 earnings calls were closely grouped based on the "sector" designation to which their respective companies belonged.

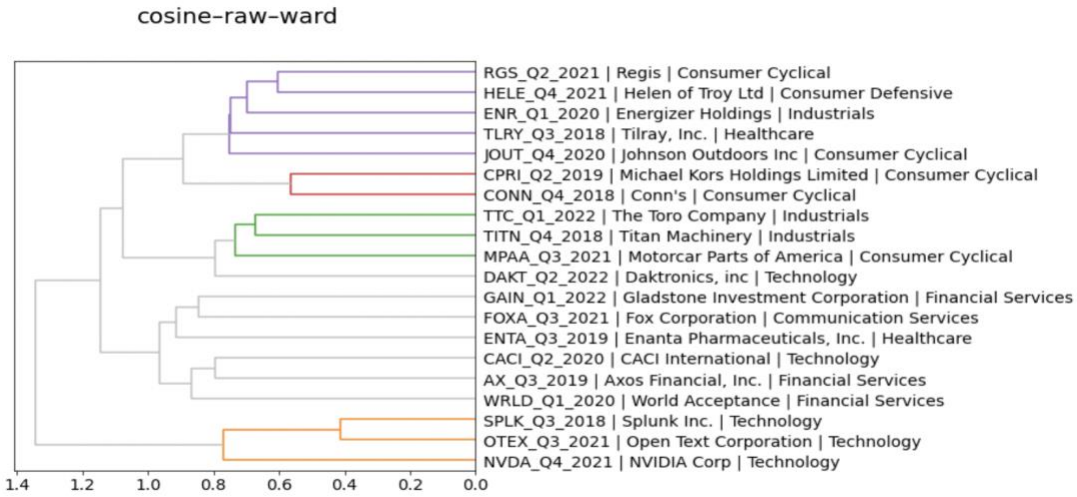

Figure 2: *Hierarchical clustering of 20 sampled earnings calls, using cosine similarity*

While some anomalies exist within the dendrogram, they can often be explained by closer examination of company business models. For instance, “Motorcar Parts of America” – belonging to the “Consumer Cyclical” sector – was incorrectly paired with two “Industrial” sector companies. However, given that Motorcar Parts of America is a manufacturer of aftermarket automobile components, it makes sense that it was grouped with two companies whose business models involve heavy machinery.

The strong relationship between earnings call content and industry association is reflected by principal component analysis as well. As seen in Figure 3, earnings calls are clearly grouped by sector along principal component 0. The associated COMPINF table (Figure 4) further suggests that this component divides sectors along a spectrum – with virtual “software/cloud” enterprises on one end, and brick-and-mortar “retail/store” businesses on the other.

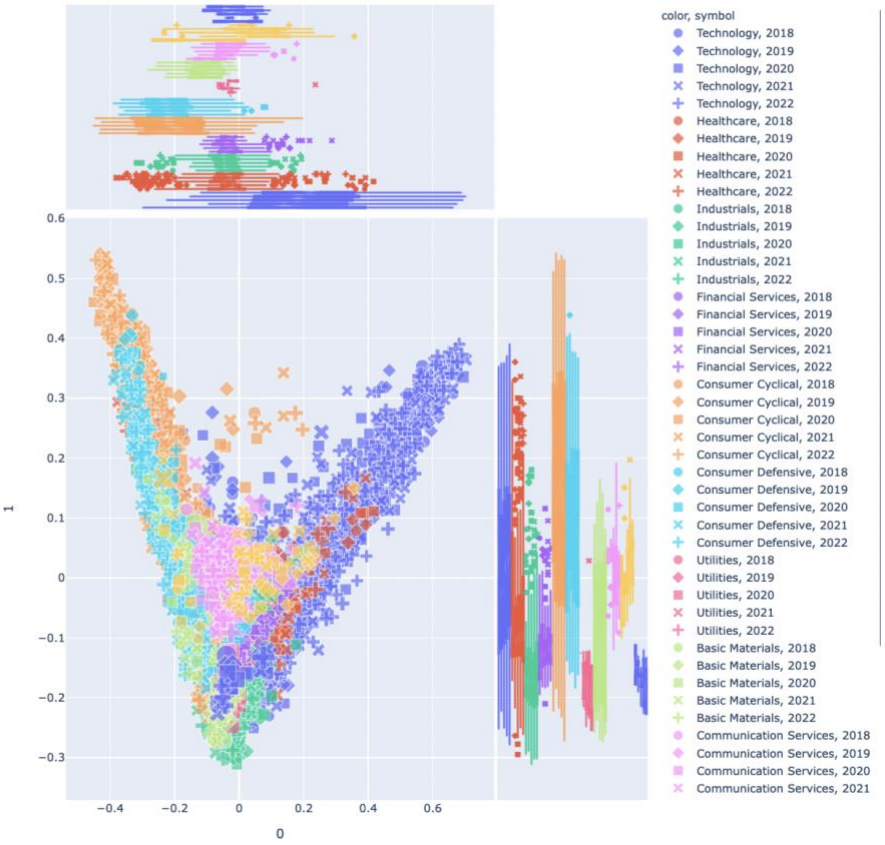

Figure 3: *PCA of earnings calls with shapes indicating quarter and color representing industry association*

pc_id	pos	neg
0	cloud security subscription software enterprise	stores brands store brand retail
1	cloud stores store brands brand	backlog projects production commercial equipment

Figure 4: *Component information table (COMPINF) of principle components 0 and 1*

COVID-19 in Earnings Calls

Of note, the term "covid" and its relatives did not yield high significance scores across any by-year VOCAB tables. Upon further inspection, this was probably due to the high absolute frequency of its use across different earnings calls (e.g. "covid": n = 23,249). Using topic modeling revealed that COVID-19 was a salient topic within earnings calls, and followed a predictable pattern between 2018-2022. Figure 5 displays the topic distribution of topic "20," which appears to strongly resemble discussions around COVID-19. In alignment with my hypothesis, the topic's concentration spikes in 2020 at the height of the pandemic's onset and tapers off thereafter. Other topics typically revolved around company business models and industry-relevant terminology (e.g. Apple Inc. earnings calls contained high concentrations of topic 15, which possessed "iphone" as a top relevant term).

year	20	21	22	23	24	25	26	27	28
2018	0.014677	0.021238	0.013614	0.005753	0.054139	0.016496	0.017221	0.014035	0.011352
2019	0.031365	0.016033	0.016849	0.010287	0.064009	0.019718	0.012269	0.029024	0.014274
2020	0.146840	0.017814	0.017900	0.006639	0.053760	0.019222	0.011920	0.030312	0.020130
2021	0.118274	0.015348	0.017461	0.006096	0.068234	0.020974	0.010482	0.024133	0.021516
2022	0.082493	0.016890	0.015924	0.006208	0.073452	0.019330	0.012377	0.031807	0.021910

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tm.TOPIC.iloc[20]
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phi_sum                                                239320
theta_sum                                              400.683
h                                                           10
top_terms_rel    coronavirus remotely essential virus shut unce...
top_terms        disruption restrictions temporary essential fa...
label            20: coronavirus remotely essential virus shut ...
Name: 20, dtype: object
```

Figure 5: *Mean topic concentrations by year (top); Top relevant terms associated with topic 20 (bottom)*

Company and Industry Sentiment Analysis Over Time

My final hypothesis involved the evolution of earnings call sentiments before and after COVID-19's onset. In order to conduct this analysis, I utilized the NRC Emotion Lexicon, which pairs a list of English terms with eight emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust) and two sentiments (positive and negative). Although I explored multiple different emotions and sentiments, I decided to focus on "fear" given its implied relationship with pandemics and public response. From a by-earnings call perspective, sentiment analysis did not yield many interesting insights over time. Figure 6 shows a sample plot of fear, joy, and polarity scores across all reported earnings call quarters for Apple Inc. As seen in the visual, fluctuations in scores don't vary much to the naked eye. Analyzing fear scores for 20 sample companies (Figure 7) is similarly uninformative – the degree of variation between individual companies and quarters makes discerning trends difficult.

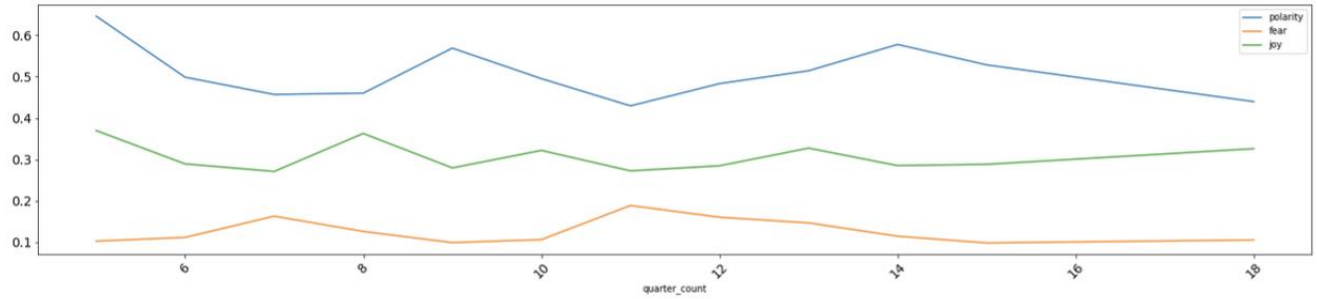

Figure 6: *Apple Inc. fear, joy, and polarity scores across quarter_count (e.g. 9 = 2 years + 1 quarter)*

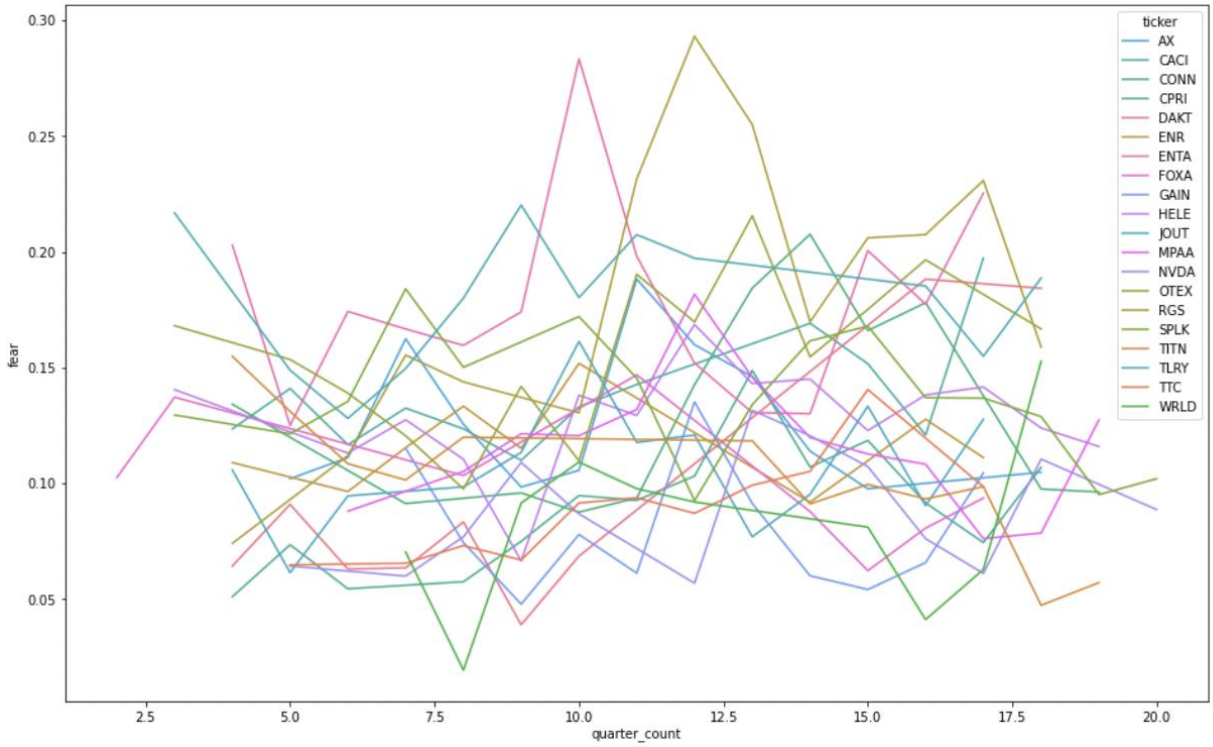

Figure 7: *Fear scores over time of 20 sampled companies*

However, averaging company fear scores by-sector on a yearly basis revealed some intuitive patterns that may reflect how different sectors responded to the pandemic. For instance, it is clear in Figure 8 that all sampled sectors displayed increases in fear scores between 2019 and 2020, but to varying degrees. The Communication Services, Consumer Cyclical, and Healthcare sectors displayed the steepest inclines in fear, likely due to their financial dependence on in-person revenue generation and proximity to the pandemic's impacts. Meanwhile, the Technology, Industrials, Consumer Defense, and Financial Services sectors may have exhibited diminished increases due to the perceived robustness of their respective business models to pandemic effects. Perhaps more interestingly, the Technology, Industrials, and Consumer Cyclical sectors experienced a subsequent *rise* in fear scores in 2021, while Healthcare, Communication Services, and Financial Services scores dropped. This aligns with the delayed supply chain shocks that many product-heavy business models felt after the pandemic's peak

(according to several prominent news sources).[2] A final note worth mentioning is the relatively high baseline of the Healthcare sector's fear score across all years. While this matter certainly merits further investigation, it is possible that company leadership discussions within the Healthcare industry exhibit a warier outlook on the world than other leadership teams when communicating with shareholders. Alternatively, language associated with "fear" annotations in the NRC Emotion Lexicon often involves bodily harm (see Figure 9), which is perhaps more commonly used to discuss products, methods, and outcomes in the Healthcare community.

Figure 8: *Average fear scores of 20 sampled companies by year, grouped/color-coded by sector*

	1909	912	3360	1839	1640	2506	716	781	347	1361
term_str	intimately	derogatory	tribunal	infestation	hemorrhage	plea	court	curse	biopsy	flinch
fear	1	1	1	1	1	1	1	1	1	1

Figure 9: *Sampled terms from the "fear" column of the NRC Emotion Lexicon. Note the inclusion of "infestation," "hemorrhage," and "biopsy" – all terms potentially used in healthcare environments*

Conclusions, Limitations, and Next Steps

In the preceding sections, I outlined an investigation of several hypotheses about earnings call transcripts between 2018 and 2022. First, I discovered evidence opposing my hypothesis that earnings calls are similar along time horizons (quarters/years), but rather are more similar within industry groupings. Second, while terminology surrounding COVID-19 did not receive high significance scores within the corpus, COVID-19 topic prevalence did follow a predictable by-year trend across companies. Finally, by-company sentiment scores between 2018-2022 varied

[2] E.g. https://www.nytimes.com/2021/10/22/business/shortages-supply-chain.html

greatly, but by-sector sentiment analysis revealed interesting implications about COVID-19's impact on different industries' business models.

It is important to note that the observations within this project do no represent causal claims, and were not scrutinized using strict measures of uncertainty. However, they do reveal interesting insights into how company leadership teams communicate issues and company performance to shareholders. With further analysis, these insights could become a stepping stone for other researchers to investigate how different industries respond to significant global events such as the COVID-19 pandemic.