CEO turnover and cultural change: a preliminary exploration

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Introduction

Chatman and O'Reilly[1] (2016) define organizational culture as a set of organization-specific social norms ideally shared by all members. Both explicit rules and tacit expectations shape social norms by informing members on what they should and should not do. Adherence to the norms is awarded, while deviance is punished. Some scholars believe that the CEOs' values and personality traits are important determinants of company culture (O'Reilly et al 2014). Meanwhile, institutional theorists argue that as companies grow and mature to a certain stage, they become resistant to CEOs' whims and personality shifts. DiMaggio and Powell (1983) show that companies must conform to the broader industry and social environment to maintain legitimacy, which limits the magnitude of cultural changes in companies. Hannan and Freeman (1984) show that mature companies develop structural inertia to maintain consistency across departments and stability across time. The structural inertia limits the speed of cultural changes in companies.

In this paper, I conducted a preliminary exploration on the impact of CEO turnover[2] on company culture. More specifically, I narrowed down to six big tech companies in the United States (Amazon, Netflix, Google, Apple, Facebook, and Microsoft) from 2008 to 2018. Among the six companies, three of them (Amazon, Netflix, and Facebook) did not experience a CEO turnover from 2008 to 2018. For Apple, Tim Cook has been temporarily running the company's daily operation since 2009 as Steve Jobs went on periodic medical leaves. In 2011, Cook officially succeeded Jobs as the new CEO of Apple. In 2014, Satya Nadella replaced Steve Ballmer as the new CEO of Microsoft. Meanwhile, Google experienced two CEO turnovers after 2008. In 2011, Eric Schmidt passed the CEO mantle to Google's president and founder Larry Page[3]. In 2015, Sundar Pichai assumed Google's CEO role as Larry Page transitioned to become the CEO of Google's parent company, Alphabet Inc. It is worth noting that all the incoming CEOs are promoted from within each company rather than appointed from outside. Table 1 summarises the CEO turnovers of the six companies.

The hypothesis of this paper is that CEO turnover has a major impact on company culture. Hence, **I expect the three companies with CEO turnovers from**

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[1] Chatman and O'Reilly (2016) define three dimensions of organizational culture: (1) cultural content, which describes what the desirable norms are; (2) cultural intensity, which describes how deeply average members have internalized the norms; (3) culture consensus, which describes how widely members agree on the norms. For this project, I plan to only study changes in company cultural content.

[2] A CEO turnover for a company means the departure of the incumbent CEO (outgoing CEO) and the appointment of a new CEO (incoming CEO).

[3] It's important to note that before Larry Page became CEO in 2011, he had a decisive influence on Google's culture, hiring process, and strategic directions as the founder and president (Levy 2011). Page replaced Schmidt as CEO in 2011 mainly because Page gained sufficient experience and maturity, rather than due to Schmidt's poor performance. As Page tweeted as he became CEO in 2011: "Adult-supervision no longer needed."

2008 to 2018 (3 treatment companies: Google, Apple, and Microsoft) to experience greater cultural change than the three companies without CEO turnovers (3 control companies: Amazon, Netflix, and Facebook). The results from my analysis fail to provide support for this hypothesis.

Table 1: CEO turnover summary of six tech companies in the U.S. (2008-2018)

Company name	CEO turnovers from 2008 to 2018	Current CEO
Amazon	No turnover	Jeff Bezos (to step down in 2021)
Netflix	No turnover	Reed Hastings (Ted Sarandos as co-CEO since 2020)
Facebook	No turnover	Mark Zuckerberg
Google	Eric Schmidt to Larry Page (2011) Larry Page to Sundar Pichai (2015)	Sundar Pichai
Apple	Steve Jobs to Tim Cook (2011)	Tim Cook
Microsoft	Steve Ballmer to Satya Nadella (2014)	Satya Nadella

Data and Methods

To measure company culture, I decided to use Glassdoor’s company review data. Glassdoor is an online review and job posting website where employees post anonymous reviews about their companies. The textual information in each review includes the “pros” and “cons” for employees’ experience at the company, as well as their “advice to management.” While I acknowledge that Glassdoor company reviews have limitations as the representation of company culture due to the potentially non-representative sample, the size of reviews (770K companies and 35M of total reviews from 2008 to 2018) are larger than any traditional survey project could achieve (Das Swain, Vedant, et al. 2020: 3). I collected the complete Glassdoor reviews of the six tech companies from 2008 to 2018 from Kaggle[4].

After some exploratory analysis of the Glassdoor review corpus, I tested the hypothesis by conducting four steps of analyses:

[4] https://www.kaggle.com/fireball684/hackerearthericsson
In this version of the data, the names of the six companies are anonymized (“startup_1” to startup_6”). But from the other Kaggle users’ online notebook using previous versions of the data (https://www.kaggle.com/kushal1996/glassdoor-reviews-eda-analysis-sentiment-analysis) and the location information, it is easy to infer the name of the six companies.

(1) Divergence Heatmaps. To get a sense of how each company’s reviews change over the years, I employed four divergence measures (Kullback-Leibler (KL), Chi2, Kolmogorov-Smirnov (KS), and Wasserstein) on 100 randomly sampled reviews from each company in each year[5]. Common stop words were filtered out. Then I visualized the divergence matrices for each company on heatmaps. If my hypothesis is correct, I expect to see clear breaks in color on heatmaps for companies during their CEO turnover years (Apple in 2009-2011, Google in 2011 and 2015, Microsoft in 2014). I also expect to see more homogenous color patterns for companies without CEO turnovers.

(2) Measuring frequency changes in 9 cultural values. Because employee reviews may cover a variety of topics, some of which have weak associations with company culture, I want to further narrow down my focus to cultural topics. As a preliminary exploration, I adopted the 9 cultural value framework from CultureX, a company dedicated to exploring culture using Glassdoor review data. I measured the frequency of keywords occurrences associated with the 9 cultural values in each year for the six companies. The frequency is measured by the sum of the total number of keyword occurrences of each value divided by the total number of reviews in each year for each company[6]. I also rescaled all frequencies by multiplying 10,000 to avoid using too many decimal points on small numbers.Table 2 shows the 9 cultural values and the keywords I specified for counting purposes. It is important to note that because the keywords that I specified are arbitrary, the goal is not to compare the relative importance of each cultural value within each company, but to measure the ***changes*** in cultural values over time and compare how the magnitude of changes differ by companies. If my hypothesis is correct, I expect to observe sharper changes in cultural values for companies during their CEO turnover years, and more stable cultural values for companies without CEO turnover from 2008 to 2018.

Table 2: The 9 cultural values and keywords

9 values	Keywords used for measuring frequencies
Agility	'agility', 'agile', 'flexible', 'flexibility', 'nimble', 'fast'
Collaboration	'collaborate', 'collaboration', 'teamwork', 'cooperate', 'cooperation' 'teammates', 'colleagues','colleague', 'coworkers', 'coworker', 'helpful', 'help'
Customer	'customer', 'customers', 'clients', 'client'

[5] For years in each company with fewer than 100 reviews, the entire sample was included in the analysis. I decided to sample 100 reviews per year rather than larger numbers because I want to minimize the effect of large gaps in sample sizes on divergence visualization.

[6] For this step of the analysis, I included all reviews for the 6 companies (no random sampling). However, because the total characters in Amazon’s reviews from 2015 to 2018 exceeded the NLP maximum limit, I decided to only keep the first 1,000,000 characters in each of those four years. This step does not impact the review data for the other five companies.

Diversity	'diversity', 'diverse', 'inclusive', 'inclusion', 'welcome', 'welcoming', 'welcomed', 'accepted', 'embraced', 'equitable', 'equity'
Execution	'execute', 'execution', 'empower', 'empowered', 'own','ownership'
Innovation	'cutting', 'edge', 'change', 'innovative', 'innovate', 'creative', 'create'
Integrity	'integrity', 'ethical', 'ethic', 'ethics', 'honest', 'honesty', 'right', 'moral', 'morality', 'character', 'honor'
Performance	'meritocratic', 'meritocracy', 'results', 'result', 'outcome', 'performance', 'perform'
Respect	'respect', 'respected', 'dignity', 'courtesy', 'friendly', 'appreciated', 'appreciation', 'appreciate', 'care'

(3) Sentiment Projections. It is possible that while cultural topics remain stable, employees' attitude toward them changed over the years. To complement the previous step of analysis, I use word projection to show how employee’s attitudes toward culture change over time. Besides using the keyword “culture”, I also included two more keywords “management”, and “leadership.” I refrained from adding too many other keywords so that the visualizations are easy to interpret. In projection figures that I will show in the results section, the three keywords appear at the top of each figure if they are more strongly associated with positive words including “good”, “great”, and “high” in terms of cosine similarity in reviews. They appear at the bottom of each figure if they are more strongly associated with negative words including “bad”, “poor”, and “low” in reviews. To make sure that each group contains enough reviews to mention all these keywords, especially during the early years of Glassdoor (before 2012), I decided to group two years of reviews rather than measuring changes for every year. It means dropping reviews in 2008, and forming 5 two-year groups: 2009-10, 2011-12, 2013-14, 2015-16, and 2017-18. Nevertheless, I had to drop Facebook and Netflix from the analysis because they did not have enough reviews during their early years to mention all these keywords. I randomly sampled 1000 reviews in each two-year group to ensure computational speed. Because reviews in 2008 were dropped, it is hard to observe changes of Apple’s keyword positions between 2008 and 2009. Hence, I decide to use Google and Microsoft as the two treatment companies, and Apple and Amazon as the two control companies. If my hypothesis is correct, I expect to observe dramatic changes in the position of the three keywords for the two treatment companies during their CEO turnover periods. I also expect to observe more stable positions of the three keywords for the two control companies.

(4) Prediction via Classification methods. In the last three steps of analysis, I looked at changes in overall content, cultural values, and attitudes. It is possible that there are other changing signals in reviews due to CEO turnovers that I failed to pick up. Hence, I decide to let machine learning algorithms identify changes for me. In this final step of

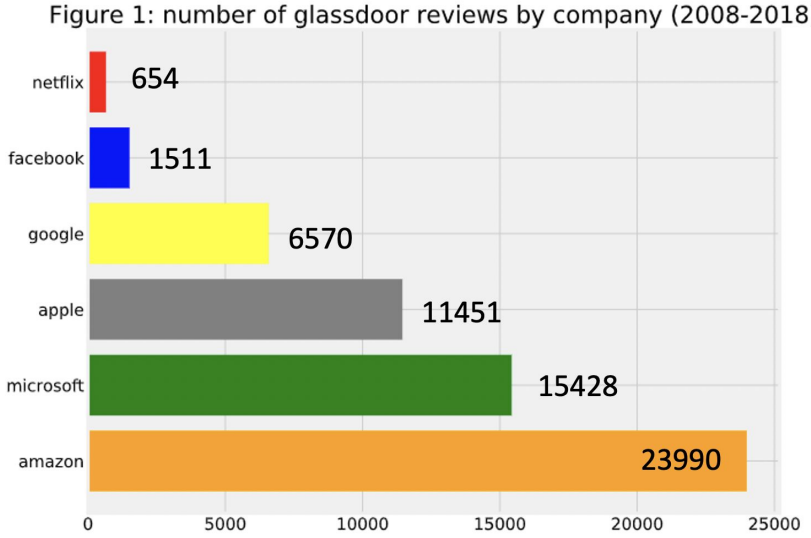
analysis, I used 8 different classification methods[7] to distinguish between reviews posted in 2012-13 and reviews posted in 2016-17 for each company. To ensure that for each company, classifications methods take in similar sample size from the two categories (2012-13 vs 2016-17), I randomly sample 1000 reviews for companies with more than 1000 reviews over the two year periods. For every review, I filtered out common English stop words and vectorized them. Each classification model is trained using 70% of total reviews (training set) and evaluated on the remaining 30% (testing set). In this step of analysis, Microsoft and Google are the treatment companies because both experienced a CEO turnover during 2015-16. If my hypothesis is correct, I expect to observe better prediction accuracies from Microsoft and Google than from the other four companies.

Results

Exploratory Analysis

The date of Glassdoor employee reviews ranges from Feb 14 2008 to Dec 11 2018. Figure 1 shows the number of reviews in each company. Figure 2 shows changes in the number of reviews in each company from 2008 to 2011. Table 3 presents a further summary of the review numbers. These figures show that Amazon had by far the most amount of reviews among the six companies, especially from 2016 to 2018. Netflix and Facebook consistently had low numbers of reviews. Especially for Facebook, they had fewer than 20 reviews per year before 2012, which I suspect contributed to some fluctuating and abnormal results in later analysis.

Figure 1: number of glassdoor reviews by company (2008-2018)



[7] These 8 classification methods are Naive Bayes (Bernoulli), Support Vector Machine (with linear kernel), K-Nearest Neighbors (k=2, weights= distance), Logistic regression (penalty = l2), Random Forest, Neural Network, Gradient Boosting, and Ada Boosting. I did not hypertune any parameters.

Figure 2: number of glassdoor reviews by company each year (2008-2018)

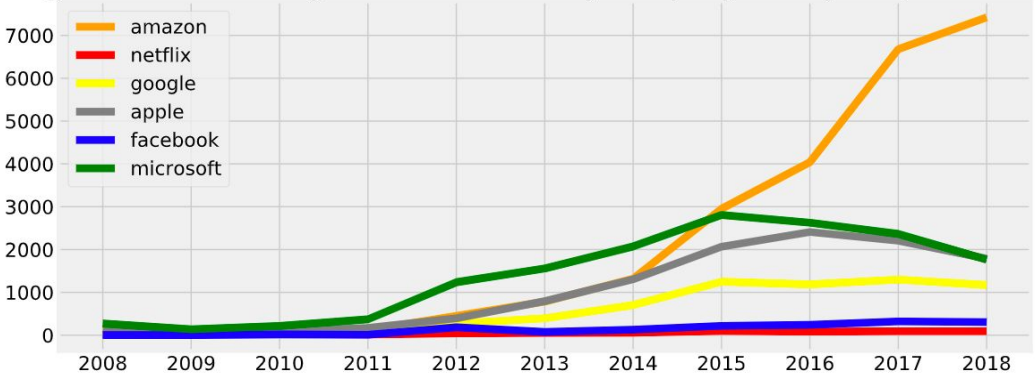


Table 3: The number of reviews on Glassdoor of the 6 tech companies per year

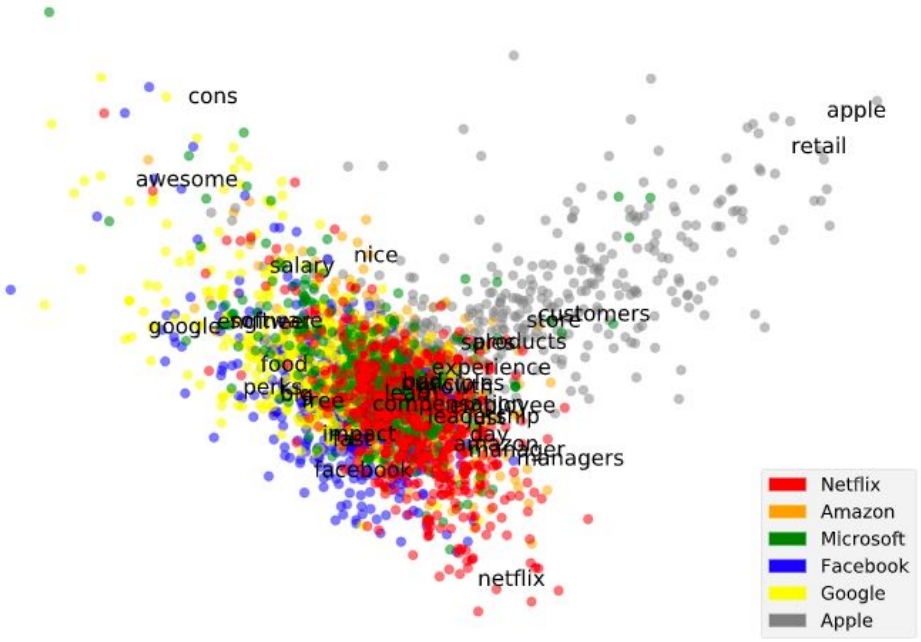
	Amazon	Netflix	Google	Apple	Facebook	Microsoft
Total	23990	654	6570	11451	1511	15428
2008	98	28	77	139	3	274
2009	68	44	51	88	3	139
2010	60	30	75	90	19	214
2011	117	19	94	171	11	371
2012	453	45	272	395	184	1238
2013	784	55	394	793	74	1559
2014	1321	60	703	1306	130	2073
2015	2951	102	1249	2066	218	2805
2016	4039	83	1186	2410	242	2626
2017	6678	94	1298	2207	321	2364
2018	7421	94	1171	1786	306	1765

To show how the reviews of the six companies differ from each other, I randomly sampled 500 reviews from each company[8]. After filtering out stop words, I vectorized

[8] I chose to randomly sample 500 reviews rather than a larger number because Netflix only has 654 reviews in total. I want the six companies to have equal representations in Figure 3.

each review and applied Principal Component Analysis to project the vectors to two dimensions. Figure 3 shows the distribution of reviews of the six companies and their most distinctive keywords. Amazon, Netflix, Microsoft’s reviews are mixed together in the middle of the graph. It means that their reviews are most similar to each other. Facebook’s reviews emphasized being “fast” and making “impact.” Google’s reviews emphasized benefits and perks (e.g. “salary”, “food”, “perks”, “free”). Apple’s reviews are most distinct from the other six companies as they emphasized “customer”, “retail”, “store”, and “product”. I suspect it is because most of Apple’s reviews are posted by employees in Apple retail stores rather than software engineers.

Figure 3: Vectorized Reviews of the six companies



(1). Divergence Heatmaps.

Before the visualization of divergence heatmaps, my hypothesis was that the heatmaps will show clear breaks in color for companies during their CEO turnover years (Apple in 2009-2011, Google in 2011 and 2015, Microsoft in 2014) and more homogenous color patterns for companies without CEO turnover. The results partially support my hypothesis.

Among the heatmaps for the four divergence measures, KS and Wasserstein graphs show clear and similar patterns. The heatmaps of KL and Chi2 graphs look homogenous for every company across the years[9]. I infer that for this particular corpus,

[9] Except for Chi2 and KL heatmaps for Facebook, which showed clear changes in color before 2012 due to low sample size.

KS and Wasserstein are more effective than KL and Chi2 in detecting divergence in content. Therefore, KS and Wasserstein heatmaps are presented in the main analysis, while KL and Chi2 heatmaps are presented in the Appendix.

Among the three companies that experienced CEO turnovers between 2008 and 2018, their KS and Wasserstein heat maps all show clear change in color during the years of CEO turnover. Figure 4 shows the KS and Wasserstein heatmaps for Apple. Readers can see that on both graphs, clear changes in color occurred in 2009, which coincided with Tim Cook’s unofficial take over of Apple as Steve Jobs went on periodic medical leave. After 2009, the color patterns remain very stable. Figure 5 shows the KS and Wasserstein heatmaps for Google. Readers can see that on both graphs, changes in color mainly occurred in 2009, 2012, and 2015, two of which coincided with Google’s two CEO turnovers (Larry Page in 2011, and Sundar Pichai in 2015). Figure 6 shows the KS and Wasserstein heat maps for Microsoft. Readers can see that clear changes in color happened in 2011 and 2016. The second change occurred two years after Nadella became CEO in 2014.

Figure 4: KS and Wasserstein heatmaps for Apple

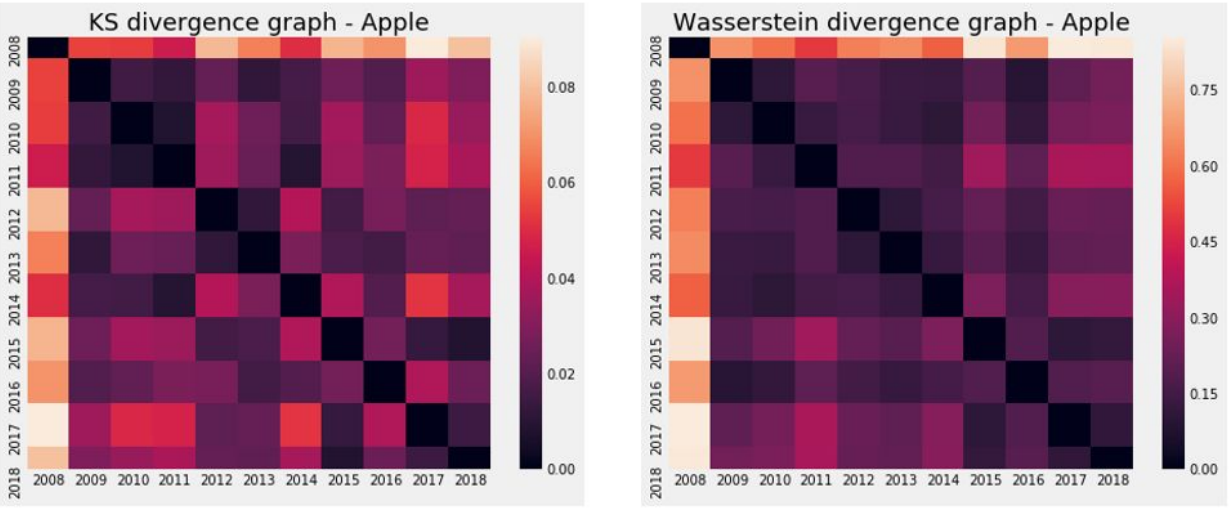


Figure 5: KS and Wasserstein heatmaps for Google

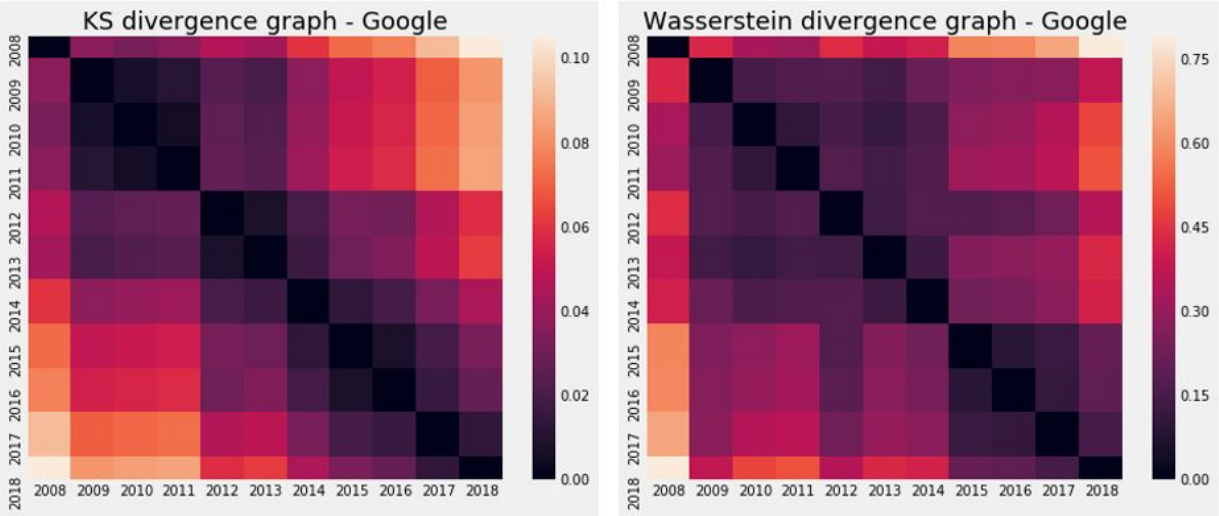
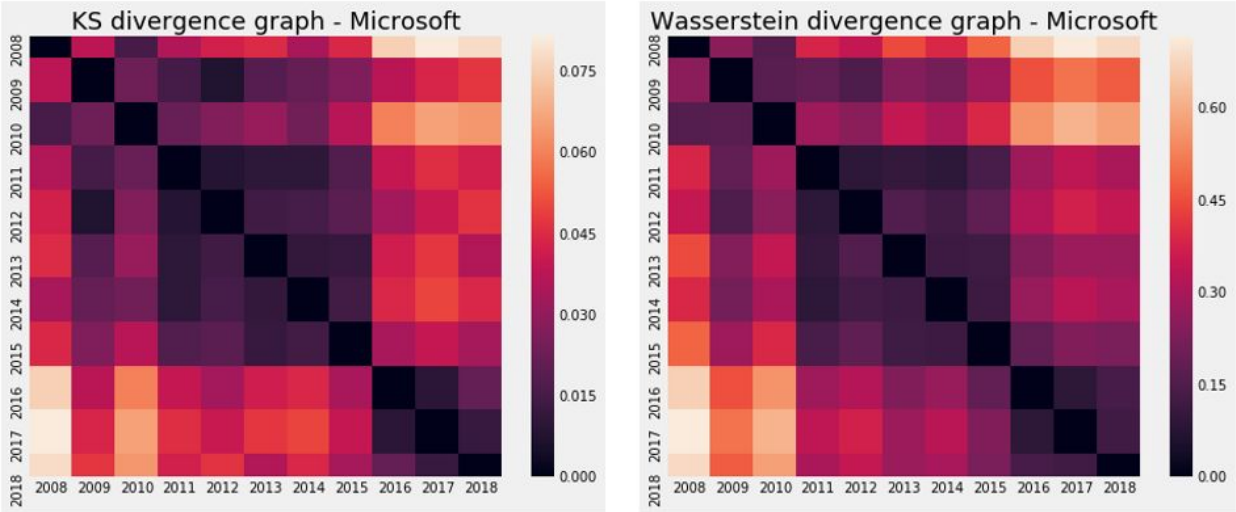


Figure 6: KS and Wasserstein heatmaps for Microsoft



Among the three companies without a CEO turnover between 2008 and 2018, their heat maps show interesting patterns as well. Figure 7 shows the divergence heat maps for Amazon. Despite no CEO turnover, a change in color pattern occurred in 2009. I currently do not have an explanation for this change. Figure 8 shows the divergence heat maps for Facebook. A clear change in color happened in 2012. There are two tentative explanations: (1) The number of Glassdoor reviews on Facebook was lower than 20 per year. The low sample size may have contributed to the dramatic change. (2) The period before 2012 coincided with Facebook’s explosive growth. In 2010, Facebook achieved net profit for the first time thanks to ad revenues. In 2012,

Facebook went public. Figure 9 shows the divergence heat maps for Netflix. Clear change in review content occurred in 2015, which I am unable to find a satisfactory explanation for.

Figure 7: KS and Wasserstein heatmaps for Amazon

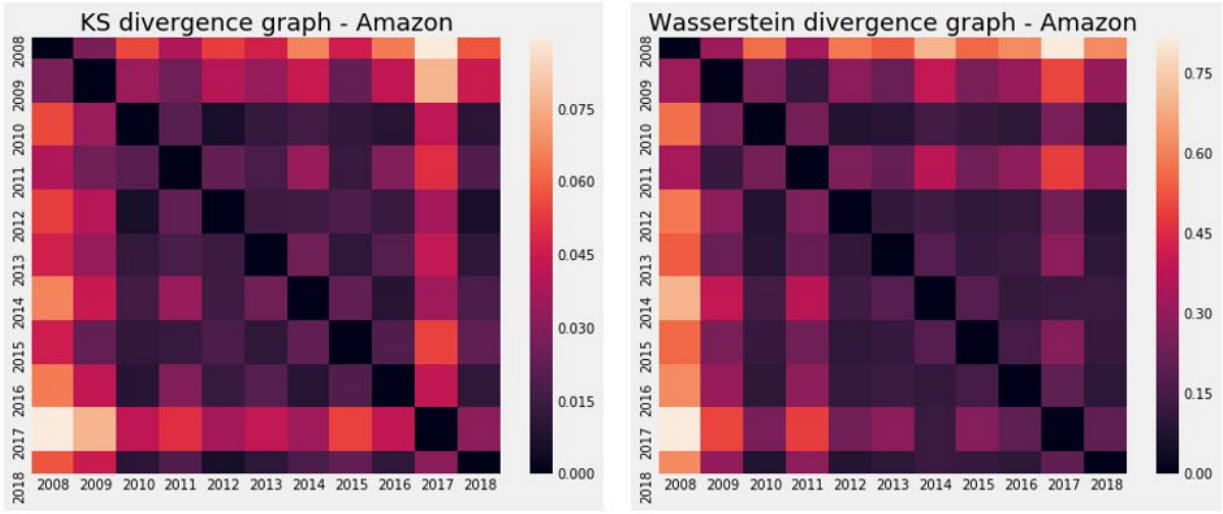


Figure 8: KS and Wasserstein heatmaps for Facebook

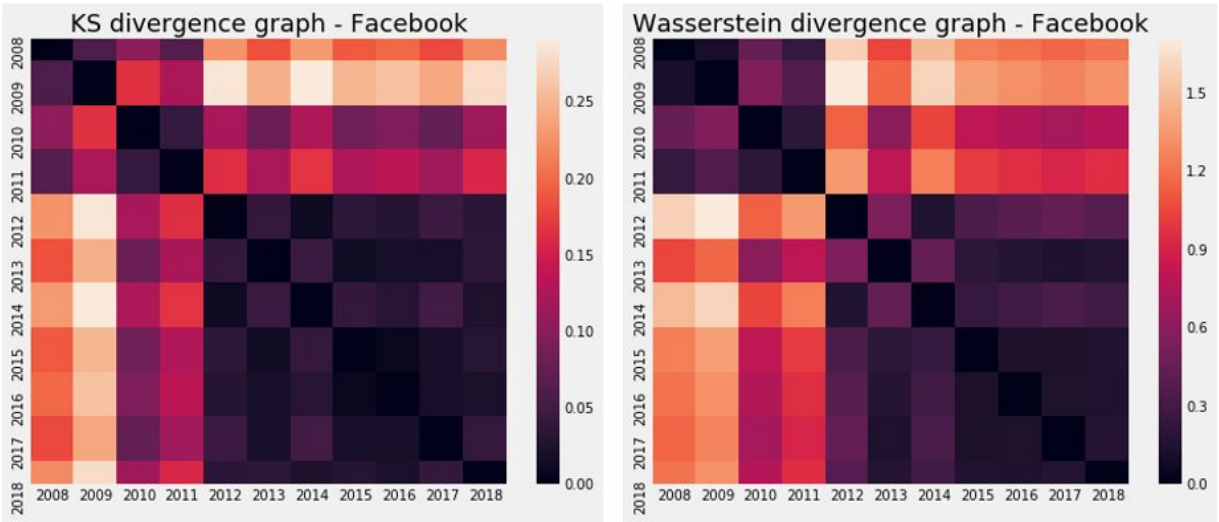
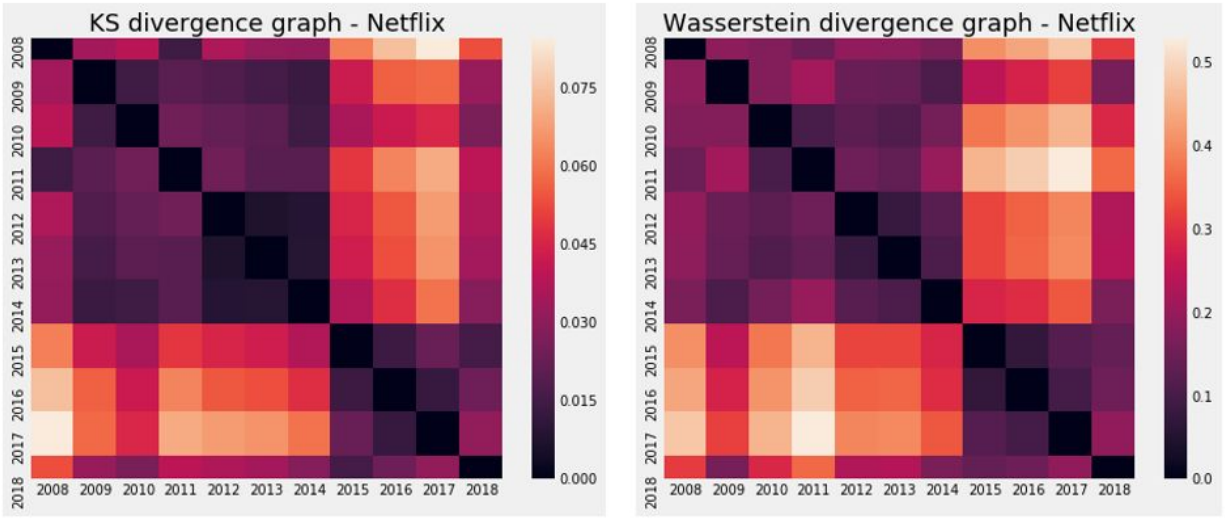


Figure 9: KS and Wasserstein heatmaps for Netflix



To conclude, the divergence heatmaps partially supported my hypothesis. For the companies with CEO turnovers, their reviews show clear changes in content during the CEO turnover period. While I cannot make causal claims, the association does suggest that the influence of CEO turnover on changes in review contents is likely and worthy of further investigation. Meanwhile, changes in review content from the three companies without CEO turnover suggest that other factors (e.g. growth, adjustment of strategic directions) may also contribute to changes in review content.

(2) Measuring frequency changes in 9 cultural values.

Before the analysis, I expect to see more dramatic changes in cultural values for the three treatment companies during their CEO turnover years, and more stable cultural values for companies without CEO turnover from 2008 to 2018. The result rejects my hypothesis.

Among the three companies that experienced CEO turnovers between 2008 and 2018, their cultural values are surprisingly stable during their CEO turnover years. Figure 10 shows the changes in the frequency of cultural values at Apple. Despite CEO turnover in 2009 to 2011, Apple’s cultural values remain very stable. Figure 11 shows the changes in cultural values at Google. The figure shows that value turbulence happened before and during its first CEO turnover (Larry Page in 2011), and gradually stabilized after 2012 despite overgoing another CEO turnover in 2015. Figure 12 shows the changes in cultural values in Microsoft. Despite undergoing a CEO turnover in 2014, Microsoft’s cultural values remain stable.

Figure 10: changes in Apple's Cultural Values over the years

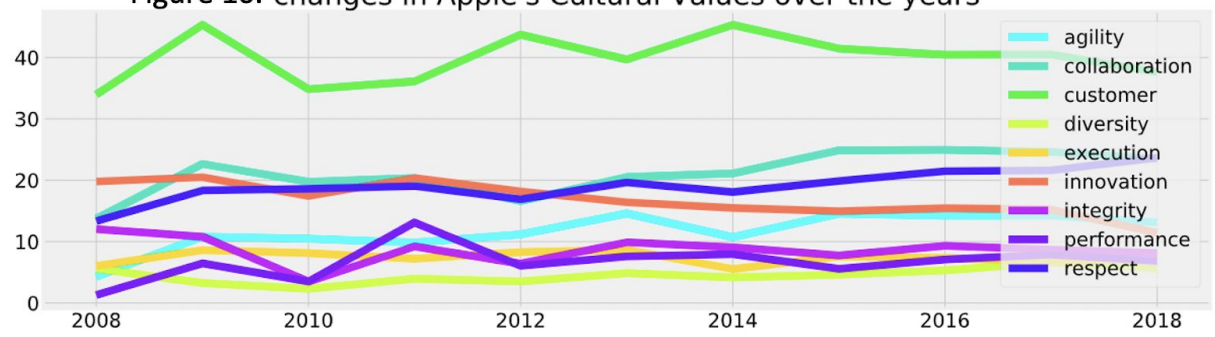


Figure 11: changes in Google's Cultural Values over the years

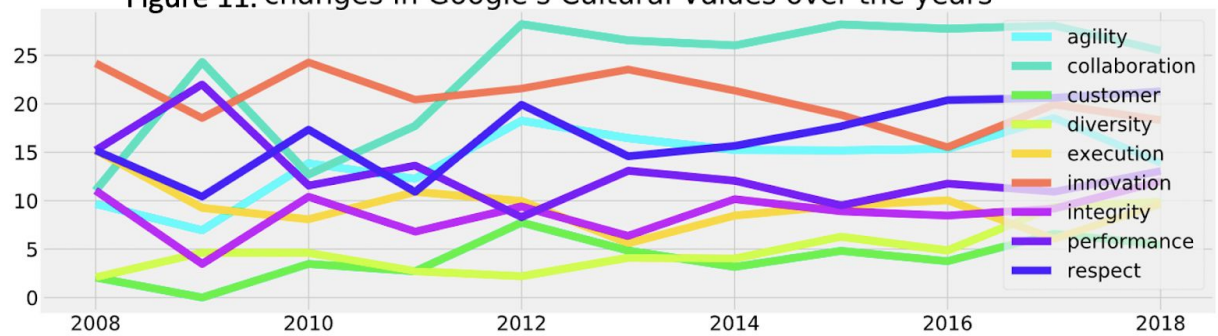
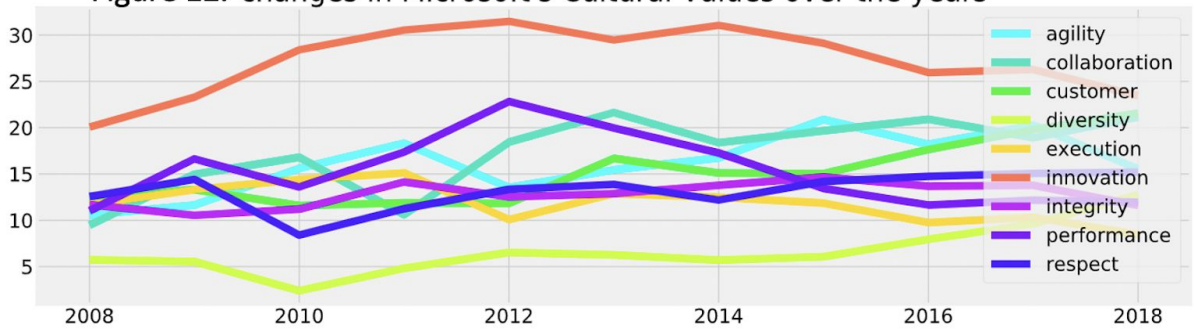


Figure 12: changes in Microsoft's Cultural Values over the years



In contrast, the three companies that did not experience CEO turnovers between 2008 and 2018 all experienced far greater magnitude of changes in cultural values. Figure 13 shows that like Google, Amazon experienced value turbulence before 2012, and gradually stabilized afterwards. Figure 14 shows that Facebook also had dramatic changes in values before 2012. Again, it is possible that low review sample size before 2012 and explosive growth both contributed to the value turbulence for Facebook. Figure 15 shows that for Netflix, cultural values are in constant fluctuation from 2008 to 2018 despite no CEO turnover.

Figure 13: changes in Amazon's Cultural Values over the years

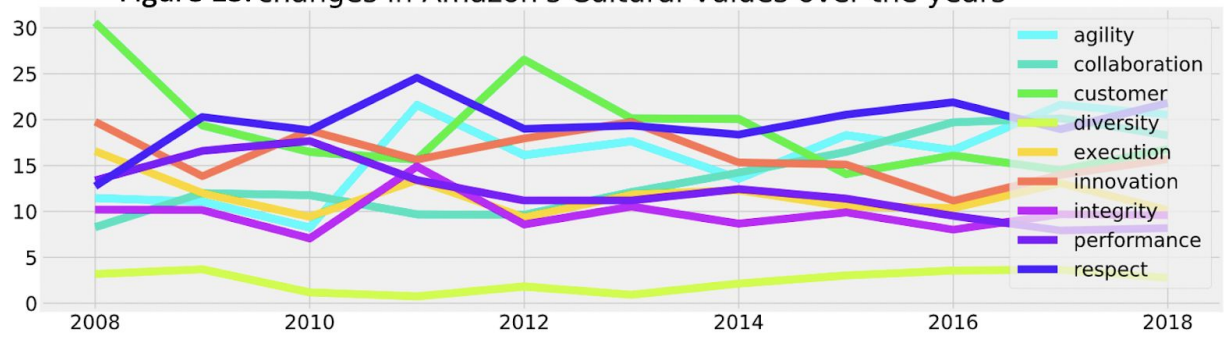


Figure 14: changes in Facebook's Cultural Values over the years

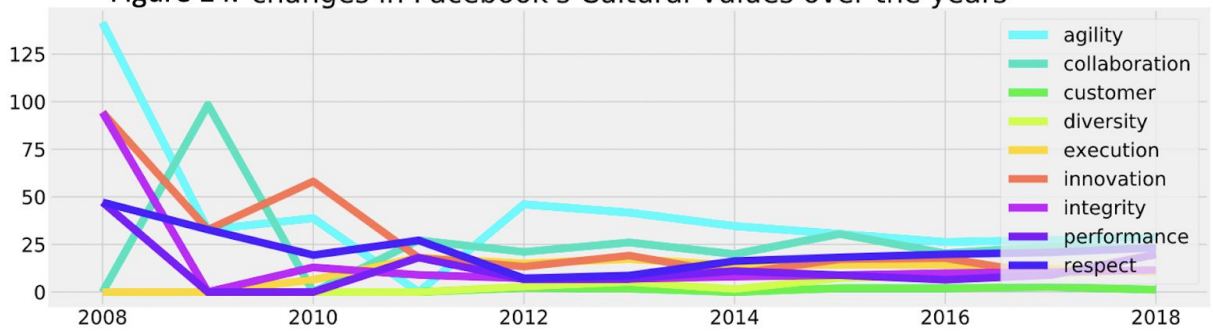
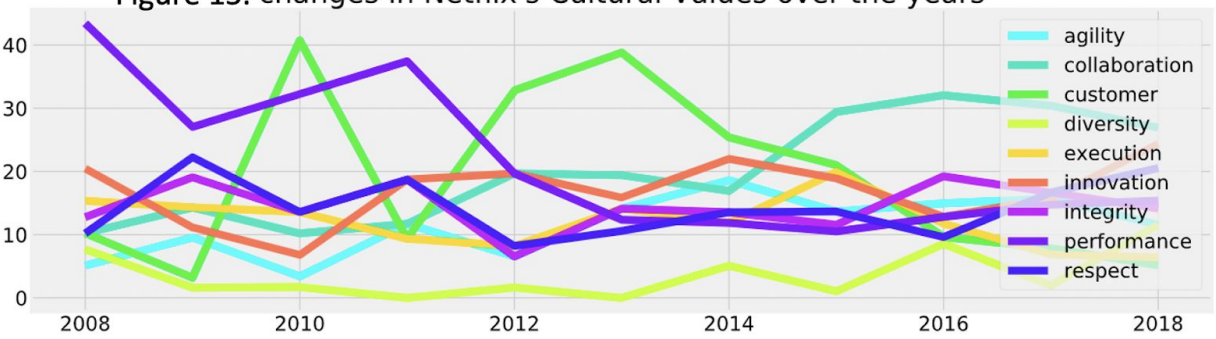


Figure 15: changes in Netflix's Cultural Values over the years



To conclude, the changes in the frequency of cultural values reject my hypothesis. The three companies without CEO turnovers experienced greater magnitude of cultural changes than the three companies with CEO turnovers. I suspect that other factors (e.g. growth, adjustment of strategic directions) had greater impact on cultural values than CEO turnovers did.

(3) Sentiment Projections

Before the analysis, I expect to observe dramatic changes in the position of the three keywords for Microsoft and Google during their CEO turnover periods. I also

expect to observe more stable positions of the three keywords for Apple and Amazon from 2009 to 2018. The results reject this hypothesis.

Figure 16 shows that the attitude projection change of the three keywords look highly similar for all four companies. For Google and Microsoft, though they experienced CEO turnovers in 2014 and 2015, their three keyword positions look stable across the years and nearly indistinguishable from those of Amazon and Apple. Among the four companies, “culture” is always viewed positively by employees, except for Amazon and Microsoft in 2009-2010. “Leadership” is always viewed negatively except for Microsoft in 2009-2010. Management is also always viewed negatively except for Amazon, Google, and Apple before 2013. It is really difficult for me to make sense of these patterns, especially the sudden drop of attitude toward “management” from 2012 to 2013 for three of the four companies. One hypothesis is that an algorithmic shift occurred on Glassdoor’s review platform in 2012, which altered how employee reviewers filled out their reviews.

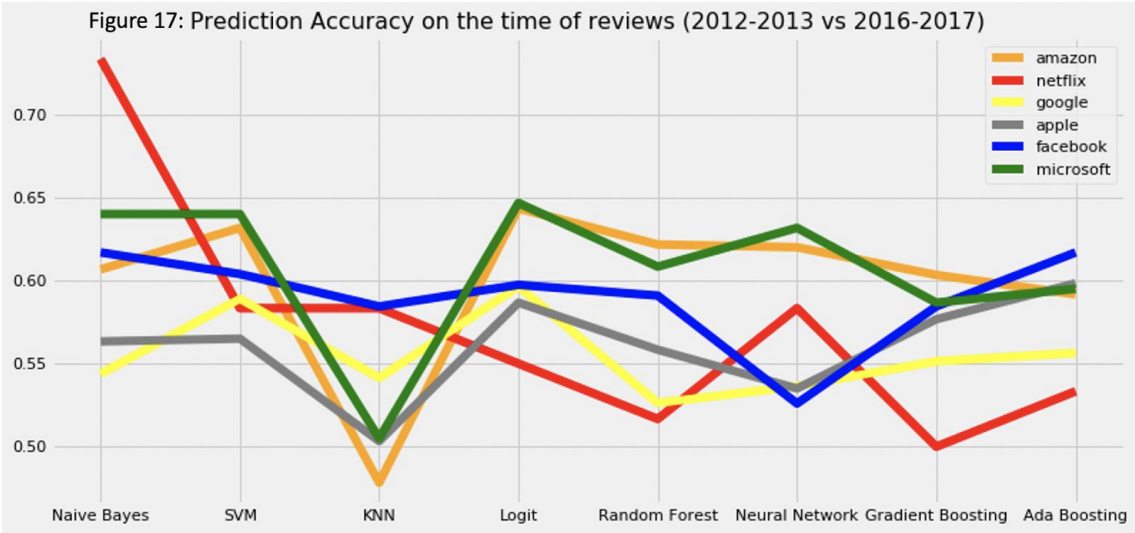
Figure 16: sentiment projections for 3 keywords

(4) Prediction via Classification methods

Before the analysis, I expect to observe better prediction accuracies from Microsoft and Google than from Amazon, Apple, Facebook, and Netflix. The results rejected my hypothesis.

Figure 17 shows the prediction accuracy of the six companies on eight classification methods. While Microsoft has the highest average prediction accuracy across the 8 classification methods, the green Microsoft line is too close to the orange

Amazon line. The average prediction accuracy for Google is clearly lower than that of Facebook and Amazon.



To further investigate the distinctive words in Google and Microsoft’s reviews before and after their CEO turnover in 2014-2015, I identified the words that most influenced Naive Bayes classifications. Table 4 summarizes the top 8 words for Google and Microsoft in each category. It is clear to see that the emphasis of Google’s employee reviews shifted from product to pay and gaining experience. While the emphasis of Microsoft’s reviews changed from its notorious stack ranking system (which ranks employees by performance and punishes the employees ranked at the bottom) to customers.

Table 4: Top 8 words that influences Naive Bayes classification for Google and Microsoft

category	Top 8 words (descending order from the most important)
Google 2012-13	Thing, product, awesome, office, feel, need
Google 2016-17	Pay, think, world, challenge, need, experience
Microsoft 2012-13	Rank, performance, competitive, stack, make, market
Microsoft 2016-17	Hour, customer, role, project, think, support

To conclude, the results show that classification methods cannot distinguish reviews written before a CEO turnover from those written afterwards. I suspect that (1) the effect of the CEO turnover is too weak to be picked up in reviews; (2) many other company wide changes had greater impact on changes in reviews. Nevertheless, the

top words from Google and Microsoft do tell a story consistent with what I have been hearing about: For Google after 2015, more new hires join the company for benefits and experience rather than for passion about the product. For Microsoft after 2014, Satya Nadella made tremendous strides in changing the company culture by eliminating the stack ranking system and fostering a more collaborative environment.

Discussion and Next Step

My hypothesis in this paper is that CEO turnovers cause changes in company culture. Results from my four steps of analyses mostly fail to support my hypothesis. The divergence heatmaps show that the CEO turnovers coincided with changes in the content of employee reviews on Glassdoor. However, the 9 cultural values frequency graphs show that there is no association between CEO turnover and sharper changes in the frequency of cultural values mentioned in reviews. The attitude projection graphs show that there is no association between CEO turnovers and changes in attitude toward culture, management, or leadership in reviews. Finally, the results from classification methods cannot distinguish reviews written before a CEO turnover from those written afterwards.

The contradictory results from divergence graphes versus the other three steps of analyses raise some questions: Since the divergence graphs show clearer changes in reviews from Microsoft and Google than from the other 4 companies around the 2015-2016 period, why did the 8 classification methods fail to pick them up? One possible explanation is sampling error. For divergence graphs, I randomly sampled 100 reviews for each company in each year. While in classification methods, I randomly sampled 1000 reviews for each company over a two year period. If given more time, I will conduct more sensitivity analysis to see if increasing the sample size for divergence graphs affect the results.

It is also worth noting that during the 2008 to 2018 period, all the incoming CEOs in these six companies were promoted from inside the company. It is possible that internally promoted CEOs have smaller impact on company culture because (1) before promotion, these executives already hold important positions within the company and have tremendous influence on company culture (e.g. Larry Page), (2) these executives are used to the company culture and are more reluctant to change it drastically. In future investigation, I am interested in analyzing glassdoor review data of companies with new CEOs appointed from outside of the company to see if these CEOs facilitated greater cultural change[10].

Another line of investigation is to explore other factors that may impact company culture. These factors may include growth in number of employees, changing in the

[10] I recently read several business biographies of outside appointed CEOs that completely changed their companies’ culture for the better. Some examples include Alan Mulally (Ford 2006-2014), as described in Hoffman (2012), and Lou Gerstner (IBM 1993-2002), as described in Gerstner (2002).

direction and focus of the company (e.g. Netflix moving from renting DVDs to online streaming), and industry-wide trends.

Finally, company culture, as revealed in Glassdoor employee reviews, may exert tremendous influence on the future direction of a company. In future investigations, I am interested in exploring how company culture may foreshadow major company events, such as IPO, Merger and Acquisition, and bankruptcy.

References

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Appendix: KL and Chi2 heatmaps

Figure 18: KL and Chi2 heatmaps for Apple

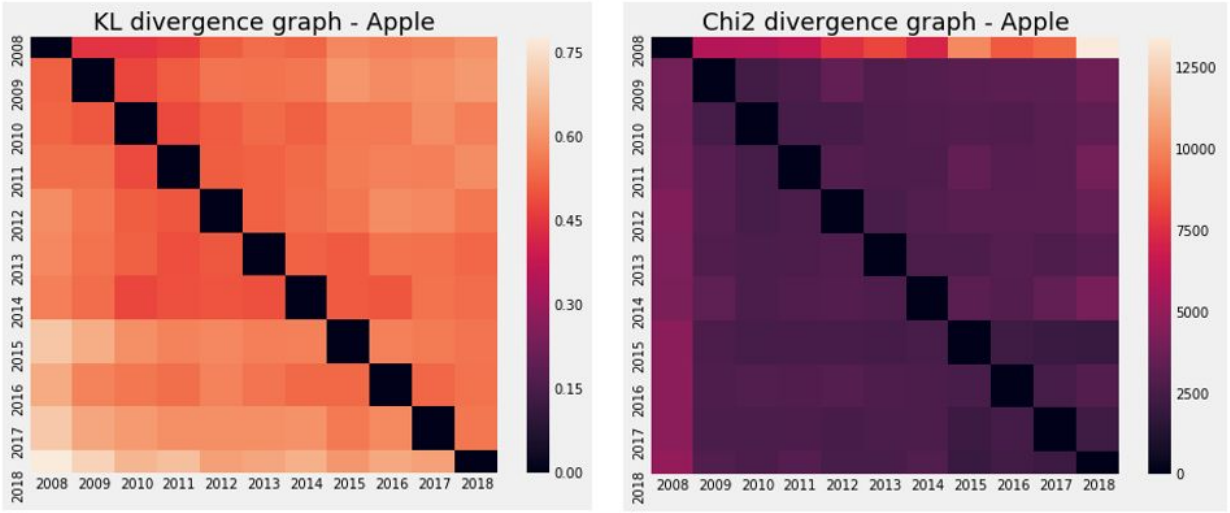

Figure 19: KL and Chi2 heatmaps for Google

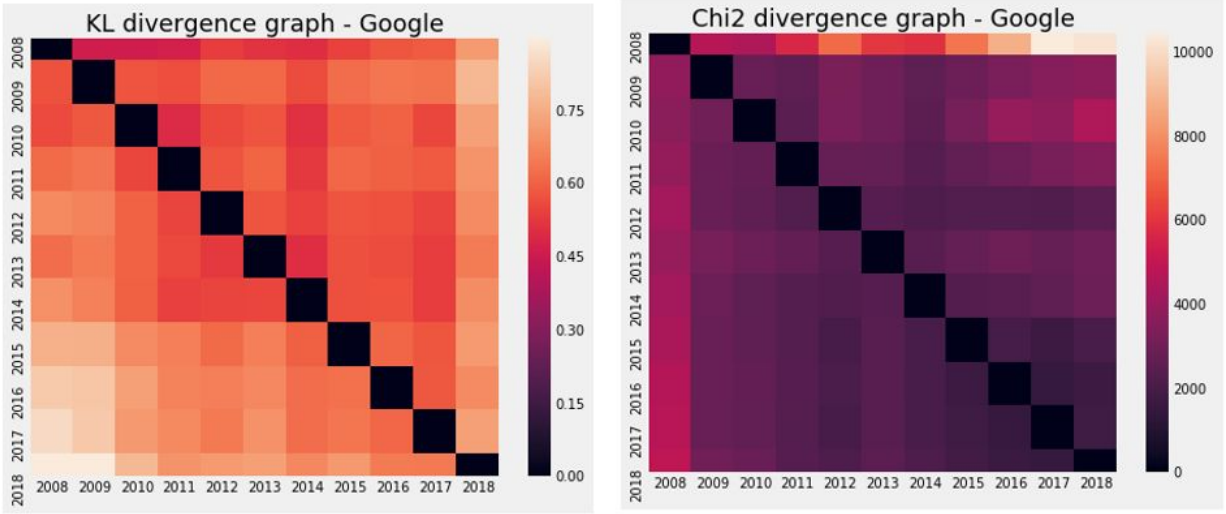

Figure 20: KL and Chi2 heatmaps for Microsoft

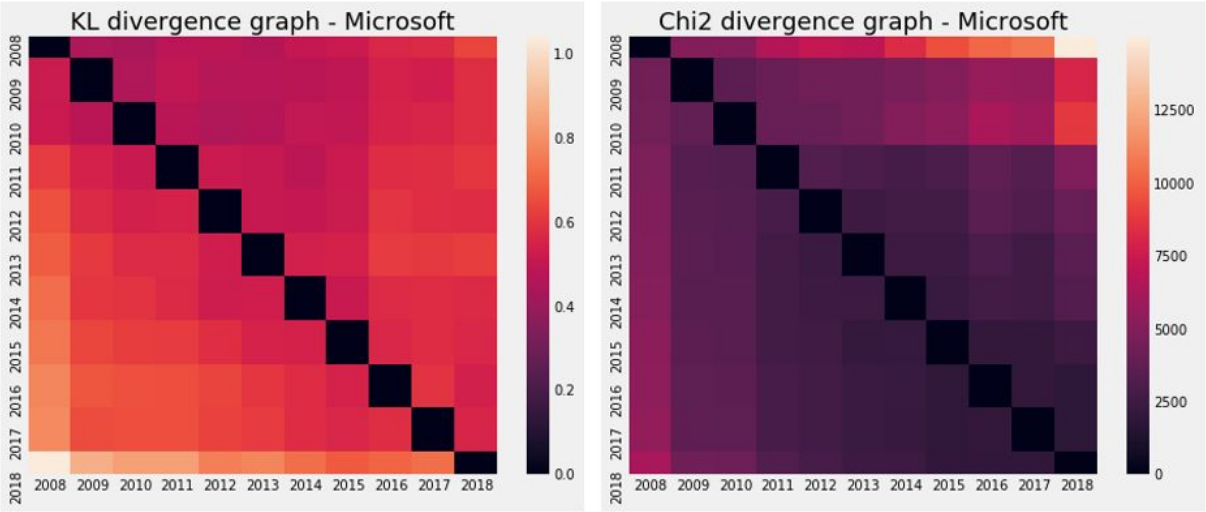

Figure 21: KL and Chi2 heatmaps for Amazon

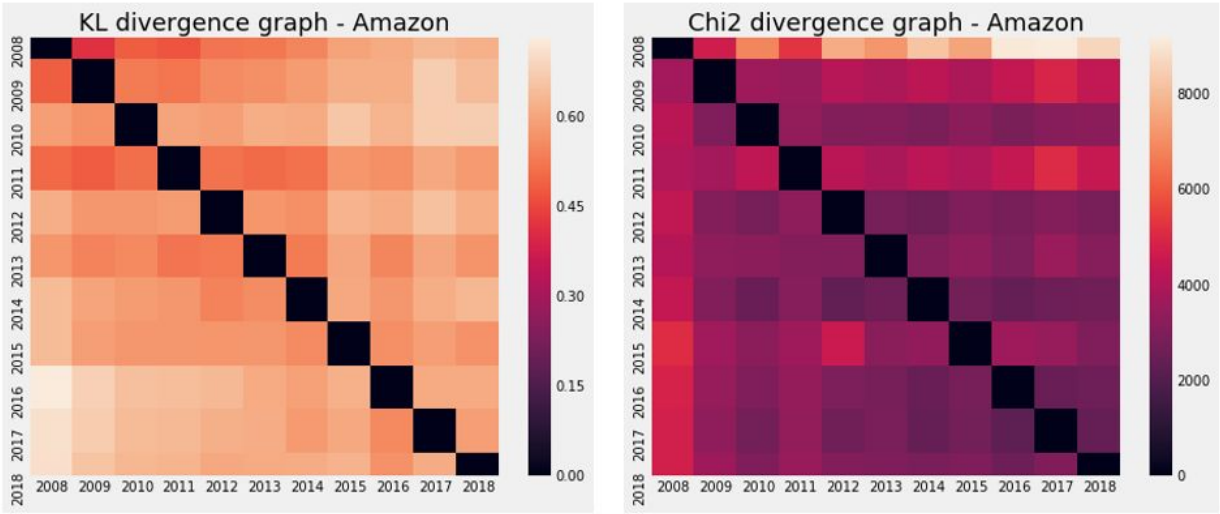

Figure 22: KL and Chi2 heatmaps for Facebook

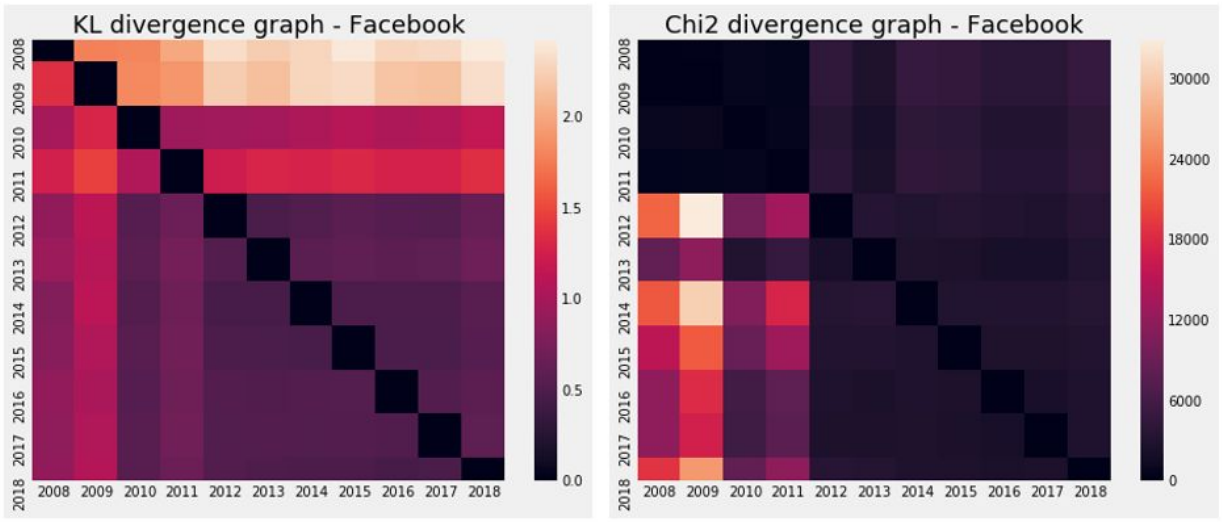

Figure 23: KL and Chi2 heatmaps for Netflix