Vrije Universiteit Amsterdam

Bachelor Thesis Information Sciences

Applying Natural Language Processing to the text of financial reports

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Abstract

This study investigates the potential predictive power of CEOs' verbal communications on future stock performance by applying Natural Language Processing (NLP) techniques to textual data derived from annual and quarterly financial reports, as well as CEO quotes. Despite the observed disparities in word frequencies between press releases related to ascending and declining stock prices, the analysis found that these patterns did not strongly predict future stock price changes. The study underscores the complexity and challenges of predicting stock prices based solely on textual data and suggests the need for a multidimensional approach for accurate stock price predictions. The findings highlight the potential utility of NLP in financial discourse analysis and its application in identifying patterns in CEOs' communications. Despite the limitations, the study opens up avenues for further research employing advanced NLP techniques, considering a broader range of data sources, and exploring additional types of corporate communications for better understanding and predicting market behavior..

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Introduction

1.1 Motivation

In the financial field, financial analysts are overwhelmed with data. However, most of this data is languishing in data warehouses and repositories because it contains an unstructured form. Unstructured text is easily processed by humans, but machines struggle when they have to process unstructured data. Data mining is a study that deals with analysing this unstructured data and uses statistical techniques to extract information for these large unstructured data collections (1). Annual reports (10-K filings) are an example of data sources that contain numerical and textual data. However, most research and information extraction on these reports have been focused on numerical data. The large chunk of data that is stored in textual form is often left out. The two main reasons not to analyse text data are that of time constraint and subjectivity (2). The amount of text is too abundant to analyse it in a manner that is not too time consuming and each person can interpret a text in a different manner. This introduces the new technique of text mining (3).

Text mining focuses on the task of extracting insightful information from text. It was first introduced by Feldman et al (4) and since then has grown into a wide set of related topics and algorithms for analysing text. Some of these topics are Information retrieval, Information Extraction from text, data mining and Natural Language Processing (NLP) (5). The latter two may seem identical, but they are not. Text mining is about discovering and extracting non-trivial knowledge from unstructured text. This also deals with information retrieval and cluster algorithms. NLP attempts to extract a fuller meaning from unstructured text. NLP also takes the grammatical structure into account, where text mining does not. NLP does this by knowledge representations that represent the grammatical properties of words and their meanings (6). Therefore, NLP can potentially

tackle the two problems of time and interpretation when it comes to analysing financial text data.

The interest of data mining has been significant in most fields, however NLP has experienced a dominant increased interest in the field of finance. In finance researchers work on cutting-edge forms of NLP. Financial qualitative market data can be utilised to improve investment decisions. It is suggested that NLP can be used in combination with CNG analysis to help financial managers to more easily read annual reports. However, financial text analysis through NLP has just started (7).

This research aims to apply text mining and NLP methods to financial statements and accompanying press releases. Text mining techniques are deployed on the data sets to generate features. On top of this the Python NLP library spaCy is used to create more insightful features such as sentiment analysis or readability scores. By doing so, this study will contribute to the growing body of literature on NLP in finance and help advance its applications in financial text analysis.

1.2 Problem Definition

The growing complexity and volume of unstructured text data in the financial sector pose significant challenges for financial analysts and decision-makers (8). While recent advancements in NLP offer promising solutions for extracting valuable insights from unstructured financial documents (9), there remains a scarcity of comprehensive evaluation of NLP techniques and tools in the context of financial text analysis. Specifically in the context of the python library spaCy. This gap in the literature has impeded the development of more effective NLP methodologies tailored for the financial sector. Furthermore, it limits the specific needs of financial analysts and their understanding of analysing textual data (10).

The evolving landscape of financial reporting also presents new challenges and opportunities. For instance, the introduction of the Inline XBRL (iXBRL) mandate by the Securities and Exchange Commission (SEC) in the U.S. in 2020 led to a shift in how companies submit their financial reports. The new format blends human-readable disclosures with machine-readable XBRL data tags within the same document, creating an integrated report (11). This shift not only underscores the continuous evolution of financial reporting but also underscores the need for effective text mining tools to process and analyse these integrated reports.

By addressing these challenges, researchers and practitioners can harness the potential of text mining in finance more effectively, leading to better-informed decision-making and improved financial outcomes.

1.3 Research question

This research will answer the following research question:

- **To what extent can Natural Language Processing gather insights from financial annual reports?**

The goal of this research question is to investigate the potential and limitations of Natural Language Processing techniques in extracting valuable insights from financial filings. To answer this primary research question, we take into consideration two sub-questions. The first sub-question is related to word frequency and has been formulated as follows:

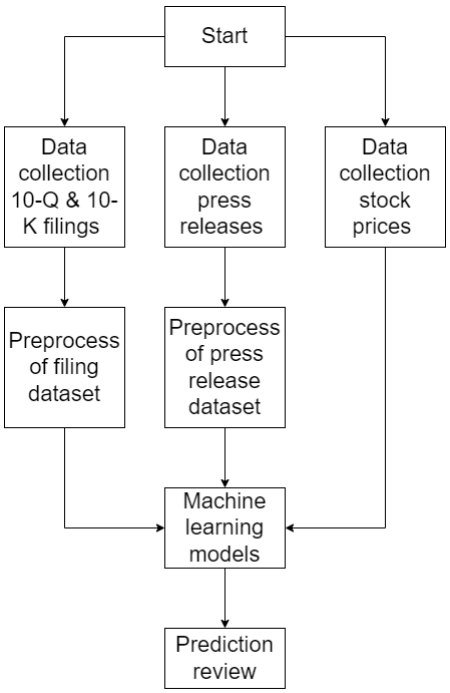
- Does certain word usage correlate with future performance of a company?

This sub-question aims to ascertain whether there is a correlation between word usage in financial reports and the long-term financial well-being of a company, as indicated by its stock price. The second sub-question builds upon the first and is formulated:

- If a correlation exists, can it be used to predict changes in a company's stock market value over the next 12 months?

This sub-question will analyse to what extent the correlation is relevant to the economic health of a company. To answer these research questions we will create two data sets. The first data set will contain annual and quarterly reports and the second data set contains CEO quotes from press releases. Both data sets have been scraped from the SEC government website. The reports are found under the code 10-K and 10-Q. The CEO quotes are found in press releases which are filed under the code exhibit 99.1. The respective stock prices of the companies will be added to each data set respectively. Furthermore, we will process the data to incorporate NLP features. If a correlation is observed between the NLP features and stock prices, we will subsequently employ two machine learning classification models, which are Random Forest and Logistic Regression. This workflow is illustrated in figure 1.1

Figure 1.1: The planned workflow



1.4 Scientific and practical contribution of research

The aim of this research was to investigate to what extent text mining and Natural Language Processing techniques can be applied to gather insights from financial reports. While there has been prior research around stock price prediction with the help of textual data (12, 13), few have delved into the potency of NLP features applied to financial reports. This research provides three main contributions. First, it presents a unique data set which contains the top 50 S&P 500 companies by volume, their respective stock prices, CEO press release quotes and text mining and NLP features. A link to this data set is found in Appendix A1. This data set can serve as a robust starting point for future exploration of data science models for stock price prediction, and it could be further augmented with additional data or refined features to enhance such models. Second, the research offers evidence that certain words from CEO quotes are more prevalent in companies with a rising stock price after a year and vice versa. Third, we introduce a mini Python library that takes as input a CEO quote from a press release and outputs a value indicating the likelihood of the quoted company experiencing a stock price rise after one year.

The practical contribution of this research aims to benefit financial analysts, investors, and decision-makers in companies. For financial analysts and investors, the insights gained

from this research can aid them in more accurately predicting stock price changes, thus enabling them to make more informed investment decisions. Moreover, it also takes away time constraints of gathering and reading the data by hand and it prevents different subjective opinions on the data, which can cause conflict between analysts. Finally, the assembled data set can serve as a rich resource for all stakeholders to examine case-by-case instances of company communications and stock price fluctuations.

1.5 Fair data

In order to ensure that the created data set in this research is usable for future reference, FAIR data principles have been applied to make the data set findable, accessible, interoperable, and reusable for future research and practical applications (14, 15). Here's how we've addressed each of these principles:

1.5.1 Findability

- (Meta)data are assigned a globally unique and persistent identifier
- Data are described with rich metadata (defined by R1 below)
- Metadata clearly and explicitly include the identifier of the data they describe
- (Meta)data are registered or indexed in a searchable resource

The data set assembled in this research has been made findable by being available on https://github.com/WoutervanZeijl/Press-releases. Each column in the data set is linked to a detailed description available in a text file named "Explanation".

1.5.2 Accessibility

- (Meta)data are retrievable by their identifier using a standardized communications protocol
- The protocol is open, free, and universally implementable
- The protocol allows for an authentication and authorization procedure, where necessary
- Metadata are accessible, even when the data are no longer available

The data can be accessed and utilized freely by anyone, because it is published publicly on github.

1.5.3 Interoperability

- (Meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation
- (Meta)data use vocabularies that follow FAIR principles
- (Meta)data include qualified references to other (meta)data

The metadata for the data set provides comprehensive descriptions for each feature, facilitating its use in diverse applications. The data set, being in the widely-used CSV format, is interoperable with various types of software, including Python, R, Tableau, and Excel, among others.

1.5.4 Reuse

- Meta(data) are richly described with a plurality of accurate and relevant attributes
- (Meta)data are released with a clear and accessible data usage license
- (Meta)data are associated with detailed provenance
- (Meta)data meet domain-relevant community standards

The metadata in our data set provides a clear and detailed account of each feature, ensuring the data can be easily understood and reused. The comprehensive descriptions for each column should assist other researchers or practitioners who wish to extend or refine the data set. All data adhere to the standards of the finance domain, enhancing its relevance and utility for future work in the field.

2

Related Literature

Numerous studies related to this topic have already been conducted in this domain. Butler and Keselj attempted to automate the analysis of annual reports. This allowed them to quickly evaluate the textual components of financial filings without the biased opinion of analysts. An n-gram model was created which performed better than the benchmark. The model was not able to capture all the information in the filing, but it captured a significant amount for above average returns. The n-gram model was combined with a bag-of-words approach to obtain better accuracy (12). Falinouss used vector space modelling with term frequency and inverse document frequency to predict stock prices with the help of news articles. The model reached an accuracy of 83%. There is a lot of research on sentiment analysis. Tetlock finds that high pessimism predicts downward momentum in the market. However, Tetlock argues that the changes of pessimistic media are dispersed throughout the trading day (13). Financial reports have also been researched with qualitative analysis. Gupta reviews text-mining in financial statements and discusses the existing literature on text mining in financial applications. Furthermore, text mining methods are discussed in the financial domain. It describes how NLP in the financial sector has developed and what tools are being used for the purpose of data mining on unstructured data (16).

Numerous literature studies show the potential use of NLP in stock market prediction. The most common category of this is sentiment analysis. Chen et al. (2010) and Mukherjee et al. (2013) both perform sentiment analysis but differ in the time interval of the data they use (17, 18). A different flavour of textual sentiment analysis is researched by Schumaker (2009). This research focuses on market trends based on breaking financial news. The authors evaluate the performance of the NLP methodology based on its time-savings effort (19).

3

Theories

This section covers theories related to the conducted NLP techniques on the project. Each theory describes the topic and what it is used for. First the theory for Natural Language Processing is described. This is followed by a description of each technique that was relevant in this project.

3.1 Natural Language Processing

Natural Language Processing in the broadest sense is the technique of enabling computers to understand and analyse natural language much in the same way as humans can. "Natural language" refers to the language that is used for everyday communication by humans. Explicit rules for these natural languages are hard to pin down because they have been passed down from generation to generation, which causes human languages to have an unstructured nature. In contrast, programming languages operate on their binary structure and are a lot faster in their processing. The degree of advancement in NLP ranges from counting words for a frequency analysis to the understanding of complete human phrases. NLP becomes increasingly more widespread. For example, smartphones support the ability to suggest predictive text based on the previous input of the user, search engines are able to retrieve text of unstructured nature and chat bots offer an interactive conversational tool that helps people to perform tasks (20).

NLP faces a challenge in analysing language that is ambiguous and can have more than 1 meaning. Furthermore, it can also be idiomatic and interpret expressions that don't follow grammatical rules.For example, the phrase "Kill two birds with one stone" would be interpreted by a human as someone who has accomplished two things at the same time. However, the NLP algorithm would most likely interpret it as saying that someone

killed two birds with one stone. We can overcome these challenges by breaking down language into its constituent parts, this is done with tokenization (see paragraph 3.2). In the early days NLP algorithms faced another challenge of handling digital data. Hard crafted rules had to be written to identify patterns in text. This limited NLP research to applications such as speech recognition and machine translation. However, in the current age NLP algorithms deploy statistical and machine learning approaches to text analysis. An example of this is sentiment analysis on financial statements. Schumaker et al. (2009) used sentiment analysis on financial statements to predict stock prices (19).

3.2 Tokenization

The first step of NLP is tokenization. It is used to split paragraphs, sentences, symbols, words and digits into smaller units called tokens. Tokens form the building blocks of the processed text and simplify the input text for further processing and analysis. This allows extraction of meaningful information and patterns in the given input text. Generally, tokenization is either done by word or per sentence. Furthermore, modern NLP packages allow for more specific rule based methods to tokenize the text. For example, we are able to split the text at punctuation instead of white space. More advanced tokenization methods used machine learning algorithms to understand patterns in the data which are used to handle the tokenization process more accurately (21).

Similar to the challenges discussed in 3.1, tokenization faces challenges in handling multi-word expressions, compound words and language specific nuances. These challenges can be language specific because different languages have varying structures that need to be taken into account.

3.3 Part-of-Speech-Tagging

Part-of-Speech-Tagging (POS) is the process of classifying words into their parts-of-speech and labelling them accordingly. For example, each token is assigned a grammatical category such as verb, noun or adjective in a given text based upon the context and the definition of the token. POS tagging helps NLP tools with question answering parsing, word sense disambiguation and machine translation. There are several approaches to POS tagging (20).

Rule-based POS tagging relies on predetermined rules that consider the morphological and contextual information before assigning a tag to a token. The most common example

of this is words ending in "-ing". These words are usually assigned with the tag verb in English. Rule-based methods are able to achieve acceptable accuracy, however, they are difficult to scale across different languages and domains because for each new language the rules have to be reviewed or rewritten.

POS tagging can also be performed with a probabilistic method. This method gathers statistical information from a corpus of text and computes the likelihood of a token having a certain tag. Moreover, this method uses the relationship of adjacent tags and their tokens. This allows for more accurate tagging and can be scaled across different languages. A downside of this is that the calculation of these statistics can be slow and computationally expensive.

Finally, thanks to the help of powerful graphical processor units, Deep Learning and Machine Learning models have recently been applied to POS tagging with success. These models are often able to achieve a very high accuracy. For example, Deshmukh & Kiwelekar (2020) achieved an accuracy of 97% (22).

In paragraph 3.1 we briefly discussed the challenge of language that can be ambiguous. Ambiguous words are the main issue that must be addressed in POS tagging. Words can have multiple meanings and the challenge lies in identifying the correct tag of a word in relation to the sentence it appears in. Another challenge is domain-specific jargon because it has limited exposure in training data. Moreover, jargon can increase the ambiguity in text and complex morphology may increase the ability for POS tagging to recognise the pattern in a sentence.

3.4 Named Entity Recognition

POS tagging proves to be helpful for Named Entity Recognition (NER). NER entities are noun phrases that refer to specific predefined categories, meaning we can classify tokens to real-world entities such as people, organisations, dates etc. NER is great for extracting structured data from unstructured text. This allows for extraction of valuable insights. For example, a financial analyst can use NER to scan a financial statement more quickly. Moreover, NER facilitates text summarization and information retrieval systems. There is also a mismatch between the growth of the amount of digital information and the resources available to manage this data. NER can alleviate this problem by offering the development of tools required for the search and discovery of unstructured data (20). NER contains two approaches that are similar to the first and third POS approaches. The first approach is rule-based. This approach contains hand crafted rules to identify an entity to its correct

class. The hand crafted approach generally obtains better precision, but this comes at the cost of a lower recall. Moreover, a hand crafted approach is very time consuming and has to be conducted by computational linguists. The second approach is the use of Machine Learning and Deep Learning models. With the help of statistics, these models can learn relationships within the text data which enables the model to handle a wider range of languages. In contrast to the rule-based approach, this approach is scalable because it doesn't require the time consuming effort that linguists have to put in. NER tools can achieve a high accuracy above 90% and is considered a solved problem. However, Marrero et al. (2013) argue that the current evaluation practices in NER do not allow us to conclude NER as a solved problem. This is because we are not able to say how well the techniques perform with other types of documents that are outside the domain of journalistics. Because there is no sound evaluation method to do so (23).

3.5 Text Classification

Text classification is the task of categorising text into predefined categories. It uses the previously discussed NER methods to structure textual data to make it ready for sentiment analysis and supervised machine learning tasks. It is thoroughly used in the domains of information retrieval, information filtering, sentiment analysis, recommendation systems and in the field of finance law and health.

The first step of text classification is preprocessing. This includes the removal of tokens that are considered stop words such as "the", "of", "and" etc. Furthermore, stemming reduces words to their root form and lemmatization reduces words to their lemma. Stemming is a simpler and faster process than lemmatization, but offers a lower accuracy of classification.

Text classification allows for feature extraction that can be utilised in machine learning models. The most common approach is the Bag of Words model. This model represents text as a matrix of word counts. Another approach is the Term Frequency-Inverse Document Frequency (TF-IDF) model. This model gives higher weights to the words that are more significant in the text in relation to a collection of textual documents. For example a jargon specific word would have more weight and have more focus in the classification process. The formula for TF-iDF is:

$$tfidf_{t,d} = tf_{t,d} \cdot \log_{10}\left(\frac{N}{df_t}\right)$$

Where tf is the relative frequency of t within document d, N the total number of documents and df the document frequency of term t.

After the feature extraction phase, text classification can be used to train machine learning models. The most common models include Naive Bayes, Support Vector Machines and Decision Trees. However, deep learning has recently been more successful in text classification tasks (24).

3.6 Sentiment Analysis

Sentiment Analysis, also known as opinion mining, originated in research as early as 2001. Das & Chen (2001) attempted a research to predict market sentiment from small investors. They found a strong link between market movements and sentiment and achieved 62% accuracy with their classifier (25). From 2001 on wards numerous studies were published with the same phrasing. The term Sentiment Analysis was used to describe the task of classifying reviews into certain sentiment polarity. This started off as a classification as either positive or negative, but later advancements in the literature started deploying statistical methods to classify sentiment numerically. Sentiment Analysis is a specific type of text classification where the goal is to determine the sentiment expressed in text data. It is thoroughly used in finance, specifically in the prediction of stock market prices. Generally speaking there are three levels on which sentiment analysis can be conducted.

On the document level the general sentiment of the text is classified. The goal of this approach is to classify the whole text to either positive, negative or neutral. For example, managerial comments on financial filings can be classified as either positive or negative in terms of financial results. Sentence level sentiment performs classification on individual sentences. Unlike the document level, individual sentences can be classified as a number, often between -1 and 1 to indicate the weight of the sentiment. On the third feature level we not only identify the sentiment in a text but also link this text to specific entities mentioned in the text. NER is especially useful in performing the third level. Moreover, sentiment analysis can either follow a rule-based approach where the sentiment is based on rules or a Machine Learning approach where sentiment is based on statistical models that identify relationships within the text data.

Even though a lot of research has been done in Sentiment Analysis it is not considered a completed problem. A problem that occurs on the document and sentence level is that the entity is not addressed. Therefore, the document level approach is not viable for text that has multiple opinions (26). Similarly to POS Tagging, ambiguity can cause problems for

the classification of sentiment. For example, words like “not” and “never” can cause wrong sentiment when used in combination with the word “great”. Ambiguity can also come in the form of sarcasm. This can cause a sentence to turn its sentiment into the opposite of which it actually is.

3.7 Classification

Classification, in the context of machine learning and NLP, is a supervised learning approach where the algorithm learns from the training data, and then uses this learning to classify new observations. Classification involves categorising text into predefined groups. For instance, emails can be classified as "spam" or "not spam", movie reviews can be classified as "positive" or "negative", and so on. The classification task starts with building a model on the training data, and then using this model to classify new data.

This research used three different classification algorithms. First Logistic Regression is used to fit data on a logistic function, which returns the probability that a given input point belongs to a rising stock price or declining stock price. When the probability is above a threshold, the instance is classified into a specific category, otherwise, it’s classified into the other. Second, Random Forest is an ensemble learning method that operates by creating a multitude of decision trees during the training phase. The decision of the majority of the trees is chosen by the random forest as the final decision. Finally, K-Nearest Neighbour is a type of instance-based learning where the function is approximated locally and all computations are deferred until classification. It classifies a new observation based on the K number of training observations nearest to that new observation. It assumes that similar things exist in close proximity. In other words, similar things are near to each other.

4

Research strategies and research methods

4.1 Strategies and Methods

To answer the main research question and the two sub-questions we used a quantitative approach to analyse the text matching the stock prices. Two separate data sets were created. The first data set consists of annual and quarterly reports. These reports are a summary of an organisation's financial performance. They inform potential investors and shareholders about the company's financial status and business activities. These are mandatory reports and are publicly published on national commissions under the filing names 10-K and 10-Q. The second data set contains data from CEO quotes. These CEO quotes can be found in the press releases that come with annual reports, more specifically exhibit 99.1. This exhibit contains additional information, such as CEO quotes and management commentary, that provides insights into the company's current state, performance, or strategic initiatives. Moreover this commentary gives information on various aspects of the company's operations, financial performance, strategic direction, or significant events.

4.1.1 10-K and 10-Q data collection

The first data set that was created consists of the 10-Q and 10-K filings from the top 10 S&P 500 companies by volume, ranging from the year 2015 - 2022. The filings were scraped from the U.S. Securities and Exchange Commission (SEC) government website. The SEC provides an electronic data gathering, analysis and retrieval system (EDGAR), which allows HTTP GET requests. There are paid API's that provide tools to scrape the filings in an efficient manner. However, the filings were scraped with python GET requests

in order to keep the cost of the research low. Considering each company has three quarterly reports and one annual report per year, the data quickly rises in size. In this research 309 filings were scraped which already exceeded a storage size of 800MB. To complement each company with the relevant stock price, GET requests to Yahoo Finance were made. To adhere to the Center for Research in Security Prices Yahoo Finance automatically adjusts the close price for stock splits and dividend and/or capital gain distributions (27). Finally, the analysis was only focused on the most relevant textual parts of the filings. These parts are Risk Factors (Item 1A), Quantitative and Qualitative Disclosures About Market Risk (Item 7A) and Financial Statements and Supplementary Data (Item 8). An example of the text contained in these sections for the company Alphabet Inc. for the 10-K filing of the year 2020 can be found in Appendix C3 and an example of the year 2021 can be found in Appendix D4. It was evaluated that the filings have huge overlap. For example using a text comparison tool (28), the Risk Factors section of the 10-K filings of 2020 and 2021 of the company Alphabet have 85.2% overlap. The 14.8% distinction comes from the added comments about the Covid-19 pandemic in 2020. The statistics of the overlap can be found in Appendix E5. Moreover, the text of these 10-Q and 10-K filings is lawyer-endorsed and shows consistent overlap because of its formal tone. The consistent use of legal language leads to little variation between the content of the filings. Therefore, there is little value in comparing the filings with each other. For these reasons the analysis was primarily focused on the second data set.

The second data set consists of the CEO quotes in the annual press releases that come with the annual reports. The press releases considered are the top 50 S&P 500 companies by volume, ranging from the year 2017 - 2022. These filings were also scraped from the SEC website and can be found under Press Release exhibit 99.1. The time span differs from the first data set because the data was significantly harder to find before the year 2017. In a few instances this wasn't the case and the data from the years 2015 and 2016 was also added. An obstacle with the creation of this press release data set in comparison to the filing data set was that the CEO quotes from these press releases had to be manually scraped. Unlike the 10-Q and 10-K filings, the press releases did not have a strict structure, therefore the quotes from the press releases had to be manually scraped instead of with a script. To be precise some companies added more textual context in their Press Releases such as a highlights section from the recent year or recent announcement. To keep the data set consistent only the CEO quotes were taken into account. Furthermore, if there was a quote from the CFO, COO or similar then this quote was also taken into account. The text below gives an indication of what the CEO quotes in the press releases entail:

"A big thank you to employees across Amazon who overcame another quarter of COVID-related challenges and delivered for customers this holiday season. Given the extraordinary growth we saw in 2020 when customers predominantly stayed home, and the fact that we've continued to grow on top of that in 2021, our Retail teammates have effectively operated in peak mode for almost two years. It's been a tremendous effort, and I'm appreciative and proud of how hard our teams have worked to serve customers," said Andy Jassy, Amazon CEO. "As expected over the holidays, we saw higher costs driven by labor supply shortages and inflationary pressures, and these issues persisted into the first quarter due to Omicron. Despite these short-term challenges, we continue to feel optimistic and excited about the business as we emerge from the pandemic. When you combine how we're staffing and scaling our fulfillment network to bring even faster delivery to more customers, the extraordinary growth of AWS with 40% year-over-year growth (and now a $71 billion revenue run rate), the addition of marquee new entertainment like The Lord of the Rings: The Rings of Power and Thursday Night Football, and a plethora of new capabilities that we're building in areas like Alexa, Ring, Grocery, Pharmacy, Amazon Care, Kuiper, and Zoox, there's a lot to look forward to in the months and years ahead."

4.2 Preprocessing and construction

The columns that were added to the data set were derived through different methods. This subsection elaborates what each column in the two data sets entail.

Table 4.1: Column explanation

Column	Description
Company	The company to which the row belongs to
Date	The date on which the filing or press release was published
Adj Close	Adjusted Close indicates the stock closing price for that given day.
Volume	The number of stock shares that were traded on this day.
Press release	The CEO quotes that were scraped for a given company and a given date
Price change 12mo	This column presents the adjusted close price change. For example if the stock price in the row is 100 and the price after 12 months is 150, then the 12 month price change for this row will be 50.
Price change 8mo	Similarly, this price change indicates the same but over a time span of 8 months instead of 12.

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Table 4.1 – continued from previous page

Column	Description
Price change 4mo	This price change indicates the change over a time span of 4 months.
Price change pct 12mo	The change in percentage of price change over a 12 month time period
Price change pct 8mo	The change in percentage of price change over a 8 month time period
Price change pct 4mo	The change in percentage of price change over a 4 month time period
Price change sign 12mo	This column contains either a value of -1 for when the price change 12mo is negative or a 1 for when the price change 12mo is positive.
Price change sign 8mo	This column contains either a value of -1 for when the price change 8mo is negative or a 1 for when the price change 8mo is positive
Price change sign 4mo	This column contains either a value of -1 for when the price change 4mo is negative or a 1 for when the price change 4mo is positive.
Compound	The Compound score is a metric that calculates the sum of all the lexicon ratings which have been normalized between -1(most extreme negative) and +1 (most extreme positive). This score has been calculated with the Vader sentiment analysis. Vader is an abbreviation for Valence Aware Dictionary and Sentiment Reasoner. It is a lexicon and rule-based feeling analysis instrument. With a mix of highlighted tokens VADER marks a score to mark each token as either positive and negative with a score between -1 and 1. The next three columns are derived from this.
Negative	A negative score is a score that has a compound score lower than -0.05
Neutral	A neutral score is a score that has a compound score between -0.05 and 0.05
Positive	A positive score is a score that has a compound score high than 0.05
Polarity	The polarity score is a float between 1 and -1. This score indicates a negative sentiment for -1 and a positive sentiment for 1. The library Textblob provides a simple API to conduct polarity and subjectivity scores.
Subjectivity	The subjectivity score is also a float between -1 and 1. According to the Textblob library it refers to the general emotion or opinion.
Text length	Text length indicates the length of the text that was scraped.

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Table 4.1 – continued from previous page

Column	Description
Word count	The word count is the amount of words that occur for the given text. More specifically, it is the text length split on white space.
Word density	The word density is a value that has been calculated by dividing the text length by the word count.
Punctuation count	This column represents the amount of punctuation that occurs per given text in the press release column.
Upper case count	The amount of upper cases that occur
Stop word count	The amount of stop words that occur. The stop words that were taken into account are the stop words that occur in the spaCy library as stop words.
Readability Dale Chall	The readability score is calculated with the Dale Chall readability metric. This metric can be found in the readability library (29). The Dale Chall score is derived from a formula that is based on the use of familiar words, rather than syllable or letter counts. It indicates how easy it is to read a certain text based upon the familiarity of the words that occur in said text
Readability Flesch reading ease	This readability score is based on the Flesch Reading Ease. It is a standard test of readability used for the U.S. Department of Defense and insurance policies.
Noun count	The amount of nouns that occur in the relevant text. The library TextBlob was used to identify each Part of Speech.
Verb count Adj count	The amount of verbs that occur in the relevant text. The amount of adjectives that occur in the relevant text.
Adv count	The amount of adverbs that occur in the relevant text.
Pron count	The amount of pronouns that occur in the relevant text.
Top words	Top words is a list of tuples. Each tuple consists of a word and the amount of occurrences for that word in the press release text
Word calculation 'Continued', 'record', 'cash', 'results', 'customers', 'fiscal', 'billion', 'cloud', 'growth', 'strong', 'fourth', 'performance', 'quarter', 'business', 'sales'	The word calculation is calculated by calculating for each word how likely it is to appear in a text that belongs to a company that has a rising stock price after a year. Then this value per word is multiplied by each other. Every word is a separate column and counts the frequency of occurrences of that specific word in the press release instance.

Named Entity Recognition (NER) can be utilized to exclude words that are irrelevant in certain contexts. For instance, specific references such as company names like "Apple," or years such as "2018," did not contribute meaningful information to our analysis. In our research, we focused on the top 25 most frequently occurring words, because words that appeared less frequently provided insufficient data for reliable interpretation. We manually filtered out irrelevant words, prioritising those that conveyed sentiment. However, in the case of a larger data set, NER could be employed to automatically exclude words with minimal or no sentimental value.

4.3 Data analysis

For the analysis part there was a specific focus on the word frequency that appeared for companies with a rising or declining stock price. Moreover, the analysis investigated if certain words were more common for companies with a rising stock price than a declining stock price and vice versa.

Furthermore, the analysis deployed two classification algorithms, namely, Random Forest and Logistic Regression. The random forest decision tree classifier uses a five cross validation to test the criterion hyper parameter Entropy and Gini. Entropy uses information gain as the criterion for splitting. Information gain is a measure to estimate the reduction in entropy after the split. A high entropy indicates that the data has a high disorder, meaning that the data points are distributed more evenly among the classes. Gini is a hyper parameter that uses impurity as the criterion for splitting. A Gini impurity measures the probability that a randomly chosen element is misclassified. Both the hyper parameter Entropy and Gini were trained on two, three, five and ten leaves. To be clear, a leaf node of 2 indicates that the Random Forest will be limited to having a maximum of 2 leaf nodes, meaning the three can only make one split.

The Logistic Regression model also deployed a cross validation of five. Furthermore, four hyper parameters were tested. The first hyper parameter is Limited-memory Broyden-Fletcher-Goldfarb-Shanno. This is an optimization algorithm that finds the optimal weights, which works well for smaller data sets. The second hyper parameter is the Library for Large Linear Classification. This works well for high-dimensional data sets with a small number of samples. Newton Conjugate Gradient is also an optimization algorithm which uses the gradient to solve the linear system of equations. The final hyper parameter is Stochastic Average Gradient and optimises the model with the stochastic gradient.

The primary metric used to evaluate the two models was an F1-score, which was derived from the corresponding confusion matrix gained from the test set. Furthermore, we examine the random forest model more in-depth to understand which features were critical for the classification process. Likewise, we look at the coefficients of the Logistic Regression to see which features gained the most weight.

Finally, to eliminate any correlation between the stock prices of companies we produced table 1 in the appendix. This table illustrates the number of positive, negative and no changes of the stock price. In this context a positive change is a price change above 5% after 12 months. A negative change is a change below 5% and no change is the boundary between $\pm 5\%$. Because the majority of companies have a more than zero negative changes it can be excluded that the companies correlate with each other and a prediction purely based on the company name is not possible.

4. RESEARCH STRATEGIES AND RESEARCH METHODS

5

Results

The purpose of the analyses was to draw conclusions from the constructed data set, specifically focusing on the textual data extracted from CEO quotes. The following sections detail the obtained results.

5.1 Class imbalance

The press release data set is composed of 248 entries. Among these, 168 instances represent a positive change in the corresponding company's stock price after one year, while the remaining 80 denote a negative shift within the same time frame. 5.1 illustrates the distribution of stock price changes. They are categorised into stock increases, decreases and neutral. In this context neutral is defined as a stock price that has not moved more than $\pm 5\%$. Furthermore, it can be observed that the three time periods have a similar distribution to each other. Logically it follows that the 12 month time period has the lowest amount of neutral instances because it had the longest time for a stock to move out of the $\pm 5\%$ boundary. The 12 month time period also experiences the highest amount of positive stock increase. The analysis was focused on the 12 month time period, because this time period has the lowest neutral occurrences and is therefore the least vulnerable to random fluctuations.

5.2 reveals that there is a high correlation between the price change over a 12-month period and that of 8 and 4 months. Therefore, the analysis over only the 12 month period is sufficient and does not have to be recalculated for other time periods.

Figure 5.1: The distribution of companies with a rising vs declining stock price

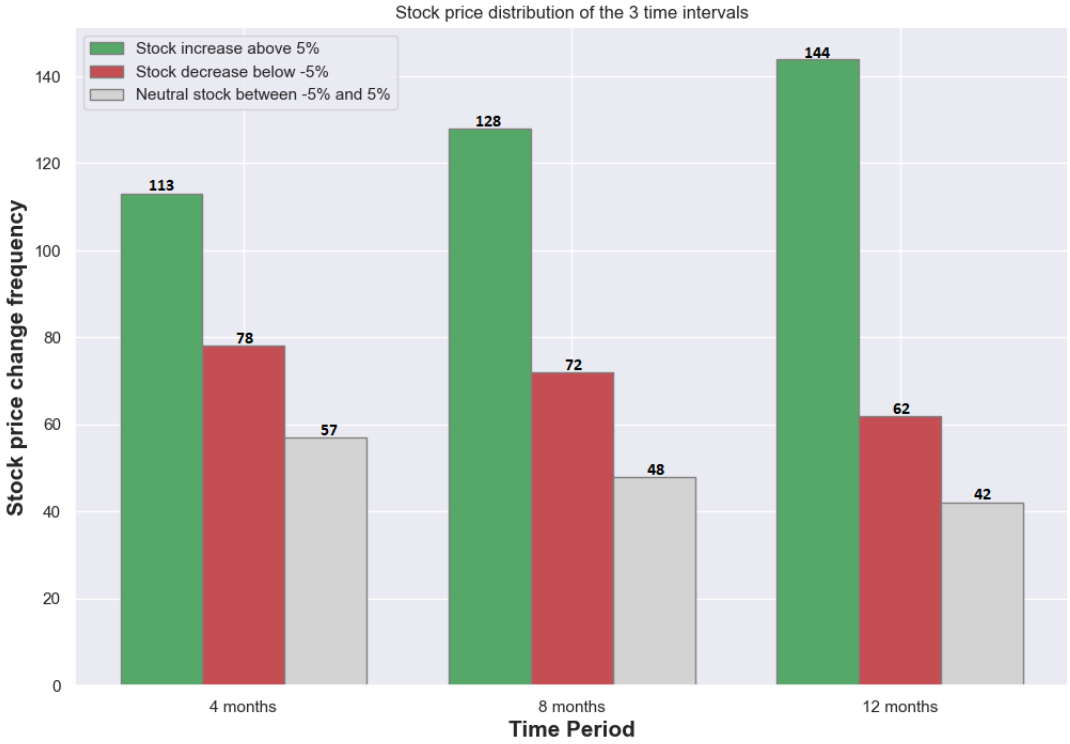
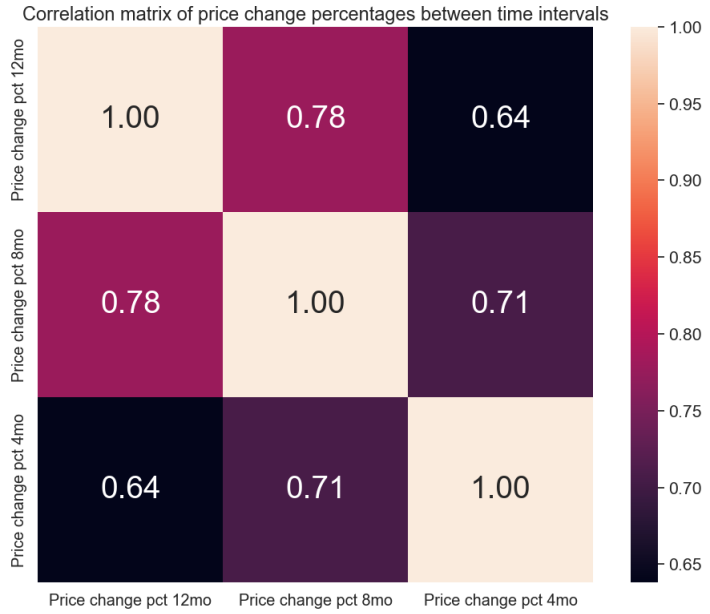


Figure 5.2: The correlation matrix of price changes between time intervals



5.2 Word occurrence

This section focuses on the words that are observed more frequently in the CEO quotes from press releases of companies that experience a rise in stock price over a year, as compared to those where the stock price descends within the same period.

Figure 5.3: Occurrence of word for a positive stock

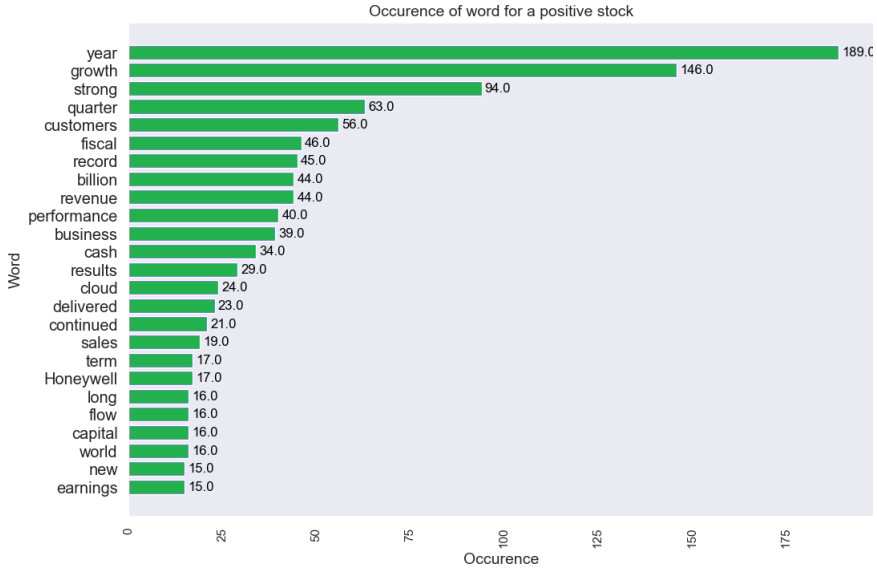
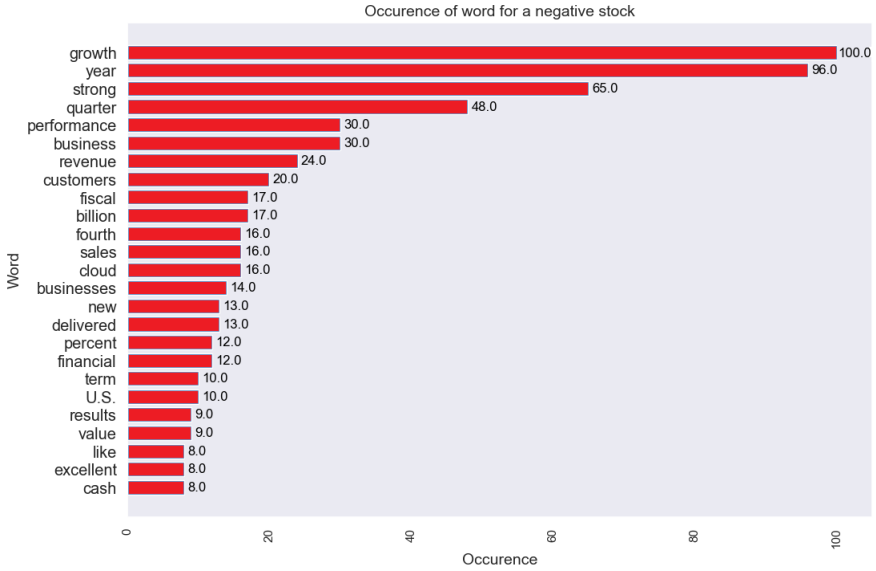
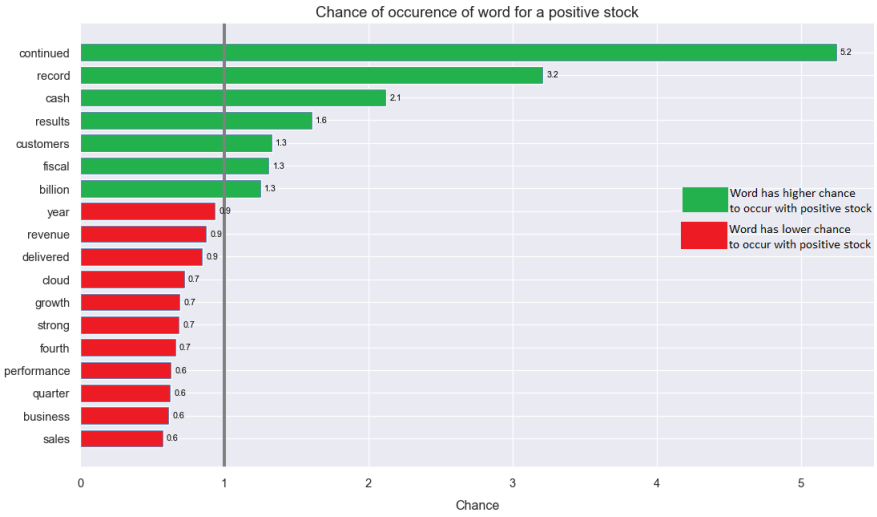


Figure 5.4: Occurrence of word for a negative stock



Figures 5.3 and 5.4 show that certain words occur more often when they are related to a rising stock price and vice versa. For instance, the word 'growth' occurs 46 more times in cases of a rising stock price. However, to ensure a meaningful comparison between the two graphs, it was crucial to account for class imbalance in the word occurrence data. This was achieved by normalising the word frequency data based on the class distribution, as presented in figure 5.5. This normalization reveals that the word 'continued' is five times more likely to appear in texts related to an ascending stock price. On the other hand, the word 'strong' is 0.6 times as likely to be found in text pertaining to a rising stock price, implying it is 1.66 times more frequent in text associated with a declining stock price.

Figure 5.5: Chance of occurrence of word for a positive stock



5.2.1 Feature selection

The following features were selected as independent variables for the machine learning models.

Negative	Neutral	Positive	polarity
subjectivity text	length	word count	word density
punctuation count	upper case word count	stop word count	readability Dale Chall
readability Flesch reading ease	noun count	verb count	adj count
adv count	pron count	continued	record
cash	results	customers	fiscal
billion	cloud	growth	strong
fourth	performance	quarter	business
sales			

Table 5.1: Chosen features for the models

5.2.2 Outcomes of the random forest model

The decision tree model reaches the highest mean F1 score on the training data with the hyper parameter Gini and 10 nodes. Using these hyper parameters on our test set we obtain the following values:

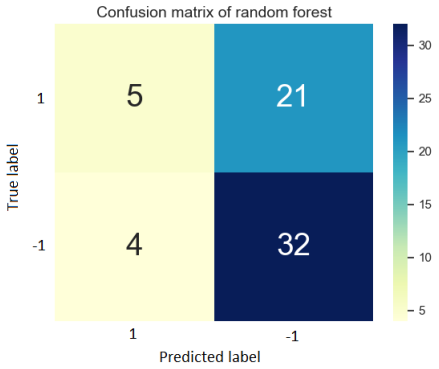
F1-score	**Precision**	**Recall**	**Accuracy**
0.286	0.556	0.192	0.597

Table 5.2: Metric table random forest.

The F1 score highlights that there is room for improvement. A better balance between precision and recall can be found. Considering there is a class imbalance in the data set where 68% of the price changes are positive, an accuracy of .597 does not outperform the baseline and shows insufficient results. These results indicate that the selected features may not be strongly predictive of the price change. The confusion matrix in figure 5.6 represents a lot of false negatives, which causes a low F1 score.

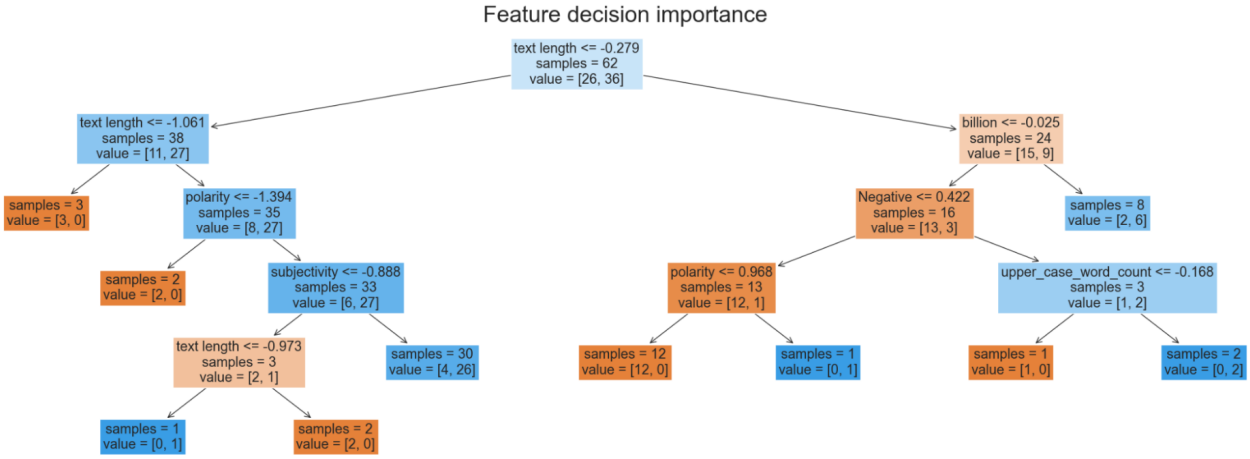
Figure 5.7 explains the feature importance of the decision tree. This model shows that text length is used as the first node. Out of the 62 samples in the test set, 38 have a text length smaller than -0.279. An important observation is that even though we showed

Figure 5.6: Confusion matrix of random forest



evidence that certain words occur more often for certain stock movements in figure 5.5, the use of these word features are only taken into account once in this model. The feature 'billion' occurs in the second depth on the right side, but no other word feature is used by the model.

Figure 5.7: Feature decision importance

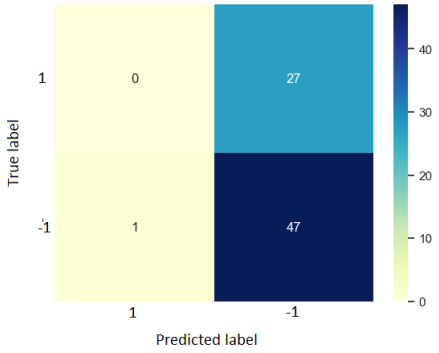


5.2.3 Outcomes of the Linear Regression model

The Logistic Regression model reaches the highest F1 score on the training data with the Library for Large Linear Classification hyper parameter. Deploying this on our test set gives us the confusion matrix in figure 5.8

We observe in this matrix that zero values were predicted to be true positives. Adjusting

Figure 5.8: Confusion matrix of Linear Regression



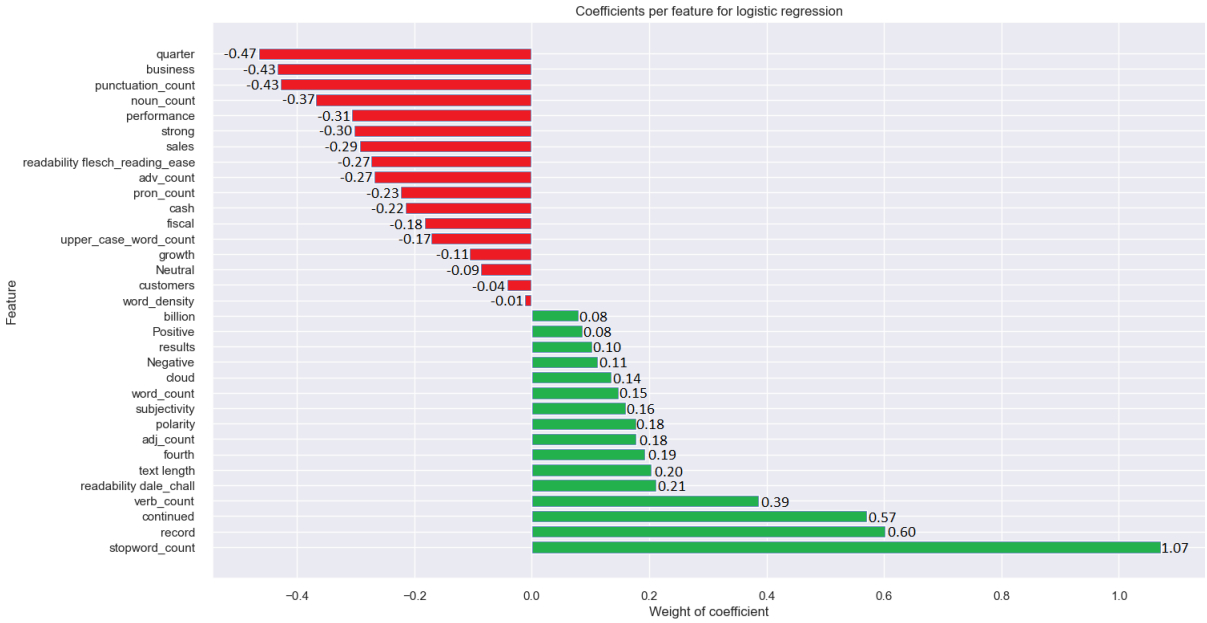
for this zero by adding 1 to it we obtain the following metrics:

F1-score	Precision	Recall	Accuracy
0.067	0.500	0.036	0.632

Table 5.3: Metric table linear regression.

The low F1 score indicates that the model was biased towards one class and does not predict the target label well. Furthermore, the random forest model with an F1-score of 0.286 performed better than the linear regression model. Finally looking at the weights of the coefficients displayed in figure 5.9 we can see that the feature 'stopword_count' had the most importance with the highest weight of 1.07. Moreover, it can be observed that the individual word features do not receive higher weights than the NLP features.

Figure 5.9: Weights of coefficients Linear Regression model



6

Discussion

6.1 Answering research questions

This research aimed to answer several questions relating to the correlation of specific word usage with a company's future performance. Text mining techniques and Natural Language Processing (NLP) were used to create features to extract insights from financial annual reports and CEO quotes from press releases. Our first sub-question, "Does certain word usage correlate with future performance of a company?" found a positive answer. As presented in Figure 5.5, there are noteworthy disparities in word frequencies between texts associated with rising and declining stock prices, indicating a noticeable pattern in word usage. However, our second sub-question, "Can this correlation be used to predict the change in stock market value in the long run?" remained unaddressed to a satisfactory extent. Despite applying two different machine learning algorithms, we found that the derived features couldn't outperform the baseline determined by the class imbalance. This result suggests that while specific word usage patterns exist, they might not directly translate into predictive models for long-term stock price changes. This leads us to the primary research question, "To what extent can Natural Language Processing gather insights from financial annual reports?" Our findings indicate that NLP provides limited value in analyzing 10-Q and 10-K reports due to their formal language and consistent overlap shown in appendix E5. However, CEO quotes within press releases proved more enlightening. Significant differences were noted in word occurrence within quotes relating to companies with rising and declining stock prices, showcasing the potential of text mining and NLP in extracting meaningful insights from certain types of corporate communications. Even though these differences in word occurrence were noted, the random forest and linear regression algorithms were not able to predict future companies performances based on the features

created. Moreover, the two models did not seem to prefer the significant occurrence of certain words over the other created features.

Finally, this research was able to create a useful data set which contains CEO quotes, stock prices and features created through text mining and Natural Language Processing. This data set is named "Press release dataset with stock prices and features" and found by following the link in Appendix A1. This data set can serve as a robust starting point for future exploration of data science models for stock price prediction, and it could be further augmented with additional data or refined features to enhance such models.

6.2 Obstacles and limitations

While our research yielded some insightful results, it's important to acknowledge the obstacles and limitations encountered during the study.

An unexpected challenge we encountered was the absence of unique text between the 10-Q and 10-K filings. Year-to-year variations in these filings were primarily due to remarks related to the COVID-19 pandemic. This research utilized an online text comparison tool to reach these conclusions. However, to automatically determine if different texts warrant comparison, spaCy offers a text comparison method (30). Moreover, to decide whether a text belongs to a 10-K filing or a press releases statement a text classification model could be developed to assess whether the texts should be used for comparison. Although this was beyond the scope of our current research, the spaCy library offers a pipeline to build such a model (31).

Additionally, the extraction of CEO quotes from press releases presented a substantial hurdle. These had to be manually scraped from Exhibit 99.1, which was a time-consuming process. This limitation restricted our analysis to the period from 2017 to 2022, as press releases before 2017 were difficult to find, thereby reducing the size of the data set.

6.3 Future Work

Our study reveals an intriguing field where further research could be beneficial. Exploring additional language features, investigating more advanced NLP techniques, or integrating other data sources might improve the predictive capabilities of the models. It might also be worthwhile to examine different corporate communications like earnings call transcripts or social media postings, which may provide different insights compared to 10-Q and 10-K reports and press releases.

In conclusion, while our study has highlighted the complexities of using text mining and NLP for stock market predictions, it also underscores the potential that lies in further investigating this topic. By refining the techniques and expanding the scope of analysis, future research could potentially unlock more of the predictive power inherent in corporate textual communications.

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[31] **text categorising**. 32

Appendix

A1 Link to the dataset and mini python library

https://github.com/WoutervanZeijl/Press-release-dataset

B2 Company price correlation

Table 1: Company correlation

Company	Nr of positive changes	Nr of negative changes	Nr of no changes
Abbott	3	1	1
Accenture	4	1	0
Adobe	4	1	0
Alphabet	2	1	0
Amazon	2	1	2
AMD	4	1	0
Amgen	4	0	1
Analog	3	1	1
Apple	4	1	1
ATT	1	3	1
Boeing	0	3	2
Booking	3	2	0
Broadcom	4	0	1
Caterpillar	4	1	0
Chevron	3	2	0
Cisco	3	1	1
Cola	3	0	2
Deere	4	1	0
Disney	1	3	0
Electric	2	3	0
Elevance	4	0	1
Exxon	2	2	1
Home	4	0	1

Continued on next page

Table 1 – continued from previous page

Company	Nr of positive changes	Nr of negative changes	Nr of no changes
Honeywell	4	1	0
IBM	2	2	1
Intel	0	2	1
Lockhead	3	2	1
Materials	2	1	2
McDonalds	3	0	2
Meta	2	1	0
Medtronic	2	2	0
Microsoft	5	0	1
Nike	3	0	2
Nvidia	3	2	0
Oracle	3	1	1
Pfize	3	0	2
Philips	1	1	3
Prologis	3	2	0
Salesforce	4	1	0
Service	4	1	0
Starbucks	4	3	1
Stryker	3	0	2
Thermo	3	1	1
Union	4	1	0
United	5	0	0
Ups	3	2	0
Verizon	1	1	3
Visa	5	0	1
Wallmart	1	6	1

C3 Risk Factors alphabet 2020 10-K filing

ITEM 1A. RISK FACTORS Our operations and financial results are subject to various risks and uncertainties, including but not limited to those described below, which could harm our business, reputation, financial condition, and operating results. Risks Specific to our Company We generate a significant portion of our revenues from advertising, and reduced spending by advertisers, a loss of partners, or new and existing technologies that block ads online and/or affect our ability to customize ads could harm our business. We generated over 83% of total revenues from the display of ads online in 2019. Many of our advertisers, companies that distribute our products and services, digital publishers, and content providers can terminate their contracts with us at any time. These partners may

not continue to do business with us if we do not create more value (such as increased numbers of users or customers, new sales leads, increased brand awareness, or more effective monetization) than their available alternatives. Changes to our advertising policies and data privacy practices, as well as changes to other companies' advertising policies or practices may affect the advertising that we are able to provide, which could harm our business. In addition, technologies have been developed that make customized ads more difficult or that block the display of ads altogether and some providers of online services have integrated technologies that could potentially impair the availability and functionality of third-party digital advertising. Failing to provide superior value or deliver advertisements effectively and competitively could harm our reputation, financial condition, and operating results. In addition, expenditures by advertisers tend to be cyclical, reflecting overall economic conditions and budgeting and buying patterns. Adverse macroeconomic conditions can also have a material negative effect on the demand for advertising and cause our advertisers to reduce the amounts they spend on advertising, which could harm our financial condition and operating results. We face intense competition. If we do not continue to innovate and provide products and services that are useful to users, we may not remain competitive, which could harm our business and operating results. Our business environment is rapidly evolving and intensely competitive. Our businesses face changing technologies, shifting user needs, and frequent introductions of rival products and services. To compete successfully, we must accurately anticipate technology developments and deliver innovative, relevant and useful products, services, and technologies in a timely manner. As our businesses evolve, the competitive pressure to innovate will encompass a wider range of products and services. We must continue to invest significant resources in research and development, including through acquisitions, in order to enhance our technology and new and existing products and services. We have many competitors in different industries. Our current and potential domestic and international competitors range from large and established companies to emerging start-ups. Some competitors have longer operating histories in various sectors. They can use their experience and resources in ways that could affect our competitive position, including by making acquisitions, continuing to invest heavily in research and development and in talent, aggressively initiating intellectual property claims (whether or not meritorious), and continuing to compete aggressively for users, advertisers, customers, and content providers. Our competitors may be able to innovate and provide products and services faster than we can or may foresee the need for products and services before us. For example, we are investing significantly in subscription-based products and services such as YouTube, which face intense competition from large

experienced companies with well established relationships with users. Our operating results may also suffer if our products and services are not responsive to the needs of our users, advertisers, publishers, customers, and content providers. As technologies continue to develop, our competitors may be able to offer experiences that are, or that are seen to be, substantially similar to or better than ours. This may force us to compete in different ways and expend significant resources in order to remain competitive. If our competitors

are more successful than we are in developing compelling products or in attracting and retaining users, advertisers, publishers, customers, and content providers, our operating results could be harmed. Our ongoing investment in new businesses, products, services, and technologies is inherently risky, and could disrupt our current operations and harm our financial condition and operating results. We have invested and expect to continue to invest in new businesses, products, services, and technologies. The investments that we are making across Google and Other Bets reflect our ongoing efforts to innovate and provide products and services that are useful to users, advertisers, publishers, customers, and content providers. Our investments in Google and Other Bets span a wide range of industries beyond online advertising. Such investments ultimately may not be commercially viable or may not result in an adequate return of capital and, in pursuing new strategies, we may incur unanticipated liabilities. These endeavors may involve significant risks and uncertainties, including diversion of management resources and, with respect to Other Bets, the use of alternative investment, governance, or compensation structures that may fail to adequately align incentives across the company or otherwise accomplish their objectives. Within Google, we continue to invest heavily in hardware, including our smartphones and home devices, which is a highly competitive market with frequent introduction of new products and services, rapid adoption of technological advancements by competitors, short product life cycles, evolving industry standards, continual improvement in product price and performance characteristics, and price and feature sensitivity on the part of consumers and businesses. There can be no assurance we will be able to provide hardware that competes effectively. We are also devoting significant resources to develop and deploy our enterprise-ready cloud services, including Google Cloud Platform and G Suite. We are incurring costs to build and maintain infrastructure to support cloud computing services and hire talent, particularly to support and scale the Cloud salesforce. At the same time, our competitors are rapidly developing and deploying cloud-based services. Pricing and delivery models are competitive and evolving, and we may not attain sufficient

scale and profitability to achieve our business objectives. Within Other Bets, we are investing significantly in the areas of health, life sciences, and transportation, among others. These investment areas face intense competition from large experienced and well-funded competitors and our offerings may not be able to compete effectively or to operate at sufficient levels of profitability. In addition, new and evolving products and services, including those that use artificial intelligence and machine learning, raise ethical, technological, legal, regulatory, and other challenges, which may negatively affect our brands and demand for our products and services. Because all of these new ventures are inherently risky, no assurance can be given that such strategies and offerings will be successful and will not harm our reputation, financial condition, and operating results. Our revenue growth rate could decline over time, and we anticipate downward pressure on our operating margin in the future. Our revenue growth rate could decline over time as a result of a number of factors, including increasing competition and the continued expansion of our business into a variety of new fields. Changes in device mix, geographic mix, ongoing product and policy changes, product mix, and property mix and an increasing competition for advertising may also affect our advertising revenue growth rate. We may also experience a decline in our revenue growth rate as our revenues increase to higher levels, if there is a decrease in the rate of adoption of our products, services, and technologies, or due to deceleration or decline in demand for devices used to access our services, among other factors. In addition to a decline in our revenue growth rate, we may also experience downward pressure on our operating margin resulting from a variety of factors, such as the continued expansion of our business into new fields, including products and services such as hardware, Google Cloud, Google Play, gaming, and subscription products, as well as significant investments in Other Bets, all of which may have margins lower than those we generate from advertising. We may also experience downward pressure on our operating margins from increasing competition and increased costs for many aspects of our business, including within advertising where changes such as device mix, property mix, and partner agreements can affect margin. The margin we earn on revenues generated from our Google Network Members could also decrease in the future if we pay a larger percentage of advertising fees to them. We may also pay increased TAC to our distribution partners as well as increased content acquisition costs to content providers. We may also face an increase in infrastructure costs, supporting businesses such as Search, Google Cloud, and YouTube. Additionally, our spend to promote new products and services or distribute certain products and services or increased investment in our innovation efforts across Google and our Other Bets businesses may affect our operating margins. Due to these factors and the evolving nature

of our business, our historical revenue growth rate and historical operating margin may not be indicative of our future performance.

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Our intellectual property rights are valuable, and any inability to protect them could reduce the value of our products, services and brand as well as affect our ability to compete. Our patents, trademarks, trade secrets, copyrights, and other intellectual property rights are important assets for us. Various events outside of our control pose a threat to our intellectual property rights, as well as to our products, services, and technologies. For example, effective intellectual property protection may not be available in every country in which our products and services are distributed or made available through the Internet. Also, the efforts we have taken to protect our proprietary rights may not be sufficient or effective. Although we seek to obtain patent protection for our innovations, it is possible we may not be able to protect some of these innovations. Moreover, we may not have adequate patent or copyright protection for certain innovations that later turn out to be important. Furthermore, there is always the possibility, despite our efforts, that the scope of the protection gained will be insufficient or that an issued patent may be deemed invalid or unenforceable. We also seek to maintain certain intellectual property as trade secrets. The secrecy of such trade secrets and other sensitive information could be compromised, which could cause us to lose the competitive advantage resulting from these trade secrets. We also face risks associated with our trademarks. For example, there is a risk that the word “Google” could become so commonly used that it becomes synonymous with the word “search.” Some courts have ruled that "Google" is a protectable trademark, but it is possible that other courts, particularly those outside of the United States, may reach a different determination. If this happens, we could lose protection for this trademark, which could result in other people using the word “Google” to refer to their own products, thus diminishing our brand. Any significant impairment of our intellectual property rights could harm our business and our ability to compete. Also, protecting our intellectual property rights is costly and time consuming. Any increase in the unauthorized use of our intellectual property could make it more expensive to do business and harm our operating results. Our business depends on strong brands, and failing to maintain and enhance our brands would hurt our ability to expand our base of users, advertisers, customers, content providers, and other partners. Our strong brands have significantly contributed to the success of our business. Maintaining and enhancing the brands within Google and Other Bets increases our ability to enter new categories and launch new and innovative products that better serve the needs of our users, advertisers, customers, content providers, and other partners.

Our brands may be negatively affected by a number of factors, including, among others, reputational issues, third-party content shared on our platforms, data privacy and security issues and developments, and product or technical performance failures. For example, if we fail to appropriately respond to the sharing of misinformation or objectionable content on our services or objectionable practices by advertisers, or to otherwise adequately address user concerns, our users may lose confidence in our brands. Our brands may also be negatively affected by the use of our products or services to disseminate information that is deemed to be false or misleading. Furthermore, failure to maintain and enhance equity in our brands may harm our business, financial condition, and operating results. Our success will depend largely on our ability to remain a technology leader and continue to provide high-quality, innovative products and services that are truly useful and play a valuable role in a range of settings. We face a number of manufacturing and supply chain risks that, if not properly managed, could harm our financial condition, operating results, and prospects. We face a number of risks related to manufacturing and supply chain management, which could affect our ability to supply both our products and our internet-based services. We rely on other companies to manufacture many of our assemblies and finished products, to design certain of our components and parts, and to participate in the distribution of our products and services. Our business could be negatively affected if we are not able to engage these companies with the necessary capabilities or capacity on reasonable terms, or if those we engage fail to meet their obligations (whether due to financial difficulties or other reasons), or make adverse changes in the pricing or other material terms of our arrangements with them. We may experience supply shortages and price increases driven by raw material availability, manufacturing capacity, labor shortages, industry allocations, tariffs, trade disputes and barriers, natural disasters, the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity), and significant changes in the financial or business condition of our suppliers. We may experience shortages or other supply chain disruptions that could negatively affect our operations. In addition, some of the components we use in our technical infrastructure and products are available only from a single source or limited sources, and we may not be able to find replacement vendors on favorable terms in the event of a supply chain disruption. In addition, a significant hardware supply interruption could delay critical data center upgrades or expansions.

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We may enter into long term contracts for materials and products that commit us to significant terms and conditions. We may be liable for materials and products that are not

consumed due to market acceptance, technological change, obsolescences, quality, product recalls, and warranty issues. For instance, because many of our hardware supply contracts have volume-based pricing or minimum purchase requirements, if the volume of our hardware sales decreases or does not reach projected targets, we could face increased materials and manufacturing costs or other financial liabilities that could make our products more costly per unit to manufacture and negatively affect our financial results. Furthermore, certain of our competitors may negotiate more favorable contractual terms based on volume and other commitments that may provide them with competitive advantages and may affect our supply. Our products and services may have quality issues resulting from design, manufacturing, or operations. Sometimes, these issues may be caused by components we purchase from other manufacturers or suppliers. If the quality of our products and services does not meet expectations or our products or services are defective, it could harm our reputation, financial condition, and operating results. We require our suppliers and business partners to comply with laws and, where applicable, our company policies, such as the Google Supplier Code of Conduct, regarding workplace and employment practices, data security, environmental compliance and intellectual property licensing, but we do not control them or their practices. Violations of law or unethical business practices could result in supply chain disruptions, canceled orders, harm to key relationships, and damage to our reputation. Their failure to procure necessary license rights to intellectual property, could affect our ability to sell our products or services and expose us to litigation or financial claims. Interruption, interference with, or failure of our information technology and communications systems could hurt our ability to effectively provide our products and services, which could harm our reputation, financial condition, and operating results. In addition, complications with the design or implementation of our new global enterprise resource planning (ERP) system could harm our business and operations. The availability of our products and services and fulfillment of our customer contracts depend on the continuing operation of our information technology and communications systems. Our systems are vulnerable to damage, interference, or interruption from terrorist attacks, natural disasters, the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity), power loss, telecommunications failures, computer viruses, ransomware attacks, computer denial of service attacks, phishing schemes, or other attempts to harm or access our systems. Some of our data centers are located in areas with a high risk of major earthquakes or other natural disasters. Our data centers are also subject to break-ins, sabotage, and intentional acts of vandalism, and, in some cases, to potential disruptions resulting from problems experienced by facility operators. Some of

our systems are not fully redundant, and disaster recovery planning cannot account for all eventualities. The occurrence of a natural disaster, closure of a facility, or other unanticipated problems at our data centers could result in lengthy interruptions in our service. In addition, our products and services are highly technical and complex and may contain errors or vulnerabilities, which could result in interruptions in or failure of our services or systems. In addition, we rely extensively on information systems and technology to manage our business and summarize operating results. We are in the process of a multi-year implementation of a new ERP system, which will replace much of our existing core financial systems. The ERP system is designed to accurately maintain our financial records, enhance the flow of financial information, improve data management, and provide timely information to our management team. We may not be able to successfully implement the ERP system without experiencing delays, increased costs, and other difficulties. Failure to successfully design and implement the new ERP system as planned could harm our business, financial condition, and operating results. Additionally, if we do not effectively implement the ERP system as planned or the ERP system does not operate as intended, the effectiveness of our internal control over financial reporting could be negatively affected. Our international operations expose us to additional risks that could harm our business, our financial condition, and operating results. Our international operations are significant to our revenues and net income, and we plan to continue to grow internationally. International revenues accounted for approximately 54% of our consolidated revenues in 2019. In addition to risks described elsewhere in this section, our international operations expose us to other risks, including the following: • Restrictions on foreign ownership and investments, and stringent foreign exchange controls that might prevent us from repatriating cash earned in countries outside the U.S.

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• Import and export requirements, tariffs, trade disputes and barriers, and customs classifications that may prevent us from offering products or providing services to a particular market, or that could limit our ability to source assemblies and finished products from a particular market, and may increase our operating costs. • Longer payment cycles in some countries, increased credit risk, and higher levels of payment fraud. • Evolving foreign events, including Brexit, the United Kingdom's withdrawal from the European Union (EU). Brexit may adversely affect our revenues and could subject us to new regulatory costs and challenges (including the transfer of personal data between the EU and the United Kingdom), in addition to other adverse effects that we are unable to effectively anticipate. • Anti-corruption laws, such as the U.S. Foreign Corrupt Practices Act, and other local

laws prohibiting certain payments to government officials, violations of which could result in civil and criminal penalties. • Uncertainty regarding liability for services and content, including uncertainty as a result of local laws and lack of legal precedent. • Different employee/employer relationships, existence of works councils and labor unions, and other challenges caused by distance, language, and cultural differences, making it harder to do business in certain jurisdictions. Because we conduct business in currencies other than U.S. dollars but report our financial results in U.S. dollars, we face exposure to fluctuations in foreign currency exchange rates. Although we hedge a portion of our international currency exposure, significant fluctuations in exchange rates between the U.S. dollar and foreign currencies may adversely affect our revenues and earnings. Hedging programs are also inherently risky and could expose us to additional risks that could harm our financial condition and operating results. Risks Related to our Industry People access the Internet through a variety of platforms and devices that continue to evolve with the advancement of technology and user preferences. If manufacturers and users do not widely adopt versions of our products and services developed for these new interfaces, our business could be harmed. People access the Internet through a growing variety of devices such as desktop computers, mobile phones, smartphones, laptops and tablets, video game consoles, voice-activated speakers, wearables, automobiles, and television-streaming devices. Our products and services may be less popular on these new interfaces. Each manufacturer or distributor may establish unique technical standards for its devices, and our products and services may not be available on these devices as a result. Some manufacturers may also elect not to include our products on their devices. In addition, search queries are increasingly being undertaken via voice-activated speakers, apps, social media or other platforms, which could harm our business. It is hard to predict the challenges we may encounter in adapting our products and services and developing competitive new products and services. We expect to continue to devote significant resources to creating and supporting products and services across multiple platforms and devices. Failing to attract and retain a substantial number of new device manufacturers, suppliers, distributors, developers, and users, or failing to develop products and technologies that work well on new devices and platforms, could harm our business, financial condition, and operating results and ability to capture future business opportunities. Data privacy and security concerns relating to our technology and our practices could damage our reputation, cause us to incur significant liability, and deter current and potential users or customers from using our products and services. Software bugs or defects, security breaches, and attacks on our systems could result in the improper disclosure and use of user data and interference with our users and customers'

ability to use our products and services, harming our business operations and reputation. Concerns about our practices with regard to the collection, use, disclosure, or security of personal information or other data-privacy-related matters, even if unfounded, could harm our reputation, financial condition, and operating results. Our policies and practices may change over time as expectations regarding privacy and data change. Our products and services involve the storage and transmission of proprietary information, and bugs, theft, misuse, defects, vulnerabilities in our products and services, and security breaches expose us to a risk of loss of this information, improper use and disclosure of such information, litigation, and other potential liability. Systems and control failures, security breaches, failure to comply with our privacy policies, and/or inadvertent disclosure of user data could result in government and legal exposure, seriously harm our reputation and brand and, therefore, our business, and impair our ability to attract and retain users or customers. We expect to continue to expend significant resources to maintain security protections that shield against bugs, theft, misuse, or security vulnerabilities or breaches. We experience cyber attacks and other attempts to gain unauthorized access to our systems on a regular basis. We may experience future security issues, whether due to employee error or malfeasance or system errors or

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vulnerabilities in our or other parties' systems, which could result in significant legal and financial exposure. Government inquiries and enforcement actions, litigation, and adverse press coverage could harm our business. We may be unable to anticipate or detect attacks or vulnerabilities or implement adequate preventative measures. Attacks and security issues could also compromise trade secrets and other sensitive information, harming our business. While we have dedicated significant resources to privacy and security incident response capabilities, including dedicated worldwide incident response teams, our response process may not be adequate, may fail to accurately assess the severity of an incident, may not respond quickly enough, or may fail to sufficiently remediate an incident. As a result, we may suffer significant legal, reputational, or financial exposure, which could harm our business, financial condition, and operating results. Our ongoing investments in safety, security, and content review will likely continue to identify abuse of our platforms and misuse of user data. In addition to our efforts to mitigate cyber attacks, we are making significant investments in safety, security, and content review efforts to combat misuse of our services and unauthorized access to user data by third parties, including investigations and review of platform applications that could access the information of users of our services. As a result of these efforts, we could discover incidents of unnecessary access to

or misuse of user data or other undesirable activity by third parties. We may not discover all such incidents or activity, whether as a result of our data limitations, including our lack of visibility over our encrypted services, the scale of activity on our platform, or other factors, and we may be notified of such incidents or activity via third parties. Such incidents and activities may include the use of user data or our systems in a manner inconsistent with our terms, contracts or policies, the existence of false or undesirable user accounts, election interference, improper ad purchases, activities that threaten people's safety on- or offline, or instances of spamming, scraping, or spreading disinformation. We may also be unsuccessful in our efforts to enforce our policies or otherwise remediate any such incidents. Any of the foregoing developments may negatively affect user trust and engagement, harm our reputation and brands, require us to change our business practices in a manner adverse to our business, and adversely affect our business and financial results. Any such developments may also subject us to additional litigation and regulatory inquiries, which could result in monetary penalties and damages, divert management's time and attention, and lead to enhanced regulatory oversight. Problematic content, including low-quality user-generated content, web spam, content farms, and other violations of our guidelines could affect the quality of our services, which could damage our reputation and deter our current and potential users from using our products and services. We, like others in the industry, face violations of our content guidelines, including sophisticated attempts by bad actors to manipulate our hosting and advertising systems to fraudulently generate revenues, or to otherwise generate traffic that does not represent genuine user interest or intent. While we invest significantly in efforts to promote high-quality and relevant results and to detect and prevent low-quality content and invalid traffic, we may be unable to adequately detect and prevent such abuses. Many websites violate or attempt to violate our guidelines, including by seeking to inappropriately rank higher in search results than our search engine's assessment of their relevance and utility would rank them. Such efforts (known as "web spam") may affect the quality of content on our platforms and lead them to display false, misleading or undesirable content. Although English-language web spam in our search results has been reduced, and web spam in most other languages is limited, we expect web spammers will continue to seek inappropriate ways to improve their rankings. We continuously combat web spam in our search results, including through indexing technology that makes it harder for spam-like, less useful web content to rank highly. We also continue to invest in and deploy proprietary technology to detect and prevent web spam from abusing our platforms. We also face other challenges from low-quality and irrelevant content websites, including content farms, which are websites that generate large

quantities of low-quality content to help them improve their search rankings. We are continually launching algorithmic changes focused on low-quality websites. If we fail to detect and prevent an increase in problematic content, it could hurt our reputation for delivering relevant information or reduce use of our platforms, harming our financial condition or operating results. It may also subject us to litigation and regulatory inquiries, which could result in monetary penalties and damages, divert management's time and attention, and lead to enhanced regulatory oversight.

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Our business depends on continued and unimpeded access to the Internet by us and our users. Internet access providers may be able to restrict, block, degrade, or charge for access to certain of our products and services, which could lead to additional expenses and the loss of users and advertisers. Our products and services depend on the ability of our users to access the Internet, and certain of our products require significant bandwidth to work effectively. Currently, this access is provided by companies that have significant market power in the broadband and internet access marketplace, including incumbent telephone companies, cable companies, mobile communications companies, and government-owned service providers. Some of these providers have taken, or have stated that they may take measures that could degrade, disrupt, or increase the cost of user access to certain of our products by restricting or prohibiting the use of their infrastructure to support or facilitate our offerings, or by charging increased fees to us or our users to provide our offerings. Some jurisdictions have adopted regulations prohibiting certain forms of discrimination by internet access providers; however, substantial uncertainty exists in the United States and elsewhere regarding such protections. For example, in 2018 the United States Federal Communications Commission repealed net neutrality rules, which could lead internet access providers to restrict, block, degrade, or charge for access to certain of our products and services. In addition, in some jurisdictions, our products and services have been subject to government-initiated restrictions or blockages. Such interference could result in a loss of existing users, customers and advertisers, goodwill, and increased costs, and could impair our ability to attract new users, customers and advertisers, thereby harming our business. Risks Related to Laws and Regulations We are subject to increasing regulatory scrutiny as well as changes in public policies governing a wide range of topics that may negatively affect our business. We and other companies in the technology industry are experiencing increased regulatory scrutiny. For instance, various regulatory agencies, including competition, consumer protection, and privacy authorities, are reviewing aspects of our products and services. We continue to cooperate with these investigations. Prior, existing, and

new investigations have in the past and may in the future result in substantial fines and penalties, changes to our products and services, alterations to our business operations, and civil litigation, all of which could harm our business, reputation, financial condition, and operating results. Changes in international and local social, political, economic, tax, and regulatory conditions or in laws and policies governing a wide range of topics may increase our cost of doing business, limit our ability to pursue certain business models or offer certain products or services, and cause us to change our business practices. Further, our investment in a variety of new fields, including the health industry and payment services, also raises a number of new regulatory issues. These factors could harm our business and operating results in material ways. A variety of new and existing laws and/or interpretations could harm our business. We are subject to numerous U.S. and foreign laws and regulations covering a wide variety of subject matters. New laws and regulations (or new interpretations or applications of existing laws and regulations in a manner inconsistent with our practices) may make our products and services less useful, limit our ability to pursue certain business models or offer certain products and services, require us to incur substantial costs, expose us to unanticipated civil or criminal liability, or cause us to change our business practices. These laws and regulations are evolving and involve matters central to our business, including, among others: • Competition laws and regulations around the world. • Privacy laws, such as the California Consumer Privacy Act of 2018 that came into effect in January of 2020, which gives new data privacy rights to California residents, and SB-327 in California, which regulates the security of data in connection with internet connected devices. • Data protection laws passed by many states within the U.S. and by certain countries regarding notification to data subjects and/or regulators when there is a security breach of personal data. • Copyright laws, such as the EU Directive on Copyright in the Digital Single Market (EUCD) of April 17, 2019, which increases the liability of content-sharing services with respect to content uploaded by their users. It has also created a new property right in news publications that will limit the ability of some online services to interact with or present such content. Each EU Member State must implement the EUCD by June 7, 2021. In addition, there are new constraining licensing regimes that limit our ability to operate with respect to copyright protected works. • Data localization laws, which generally mandate that certain types of data collected in a particular country be stored and/or processed within that country.

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• Various U.S. and international laws that govern the distribution of certain materials to children and regulate the ability of online services to collect information from minors.

• Various laws with regard to content removal and disclosure obligations, such as the Network Enforcement Act in Germany, which may affect our businesses and operations and may subject us to significant fines if such laws are interpreted and applied in a manner inconsistent with our practices or when we may not proactively discover such content due to the scale of third-party content and the limitations of existing technologies. Other countries, including Singapore, Australia, and the United Kingdom, have implemented or are considering similar legislation imposing penalties for failure to remove certain types of content. In addition, the applicability and scope of these laws, as interpreted by the courts, remain uncertain and could harm our business. For example: • We rely on statutory safe harbors, as set forth in the Digital Millennium Copyright Act in the United States and the E-Commerce Directive in Europe, against copyright liability for various linking, caching, and hosting activities. Any legislation or court rulings affecting these safe harbors may adversely affect us. • Court decisions such as the judgment of the Court of Justice of the European Union (CJEU) on May 13, 2014 on the 'right to be forgotten,' which allows individuals to demand that Google remove search results about them in certain instances, may limit the content we can show to our users and impose significant operational burdens. • Court decisions that require Google to remove links not just in the jurisdiction of the issuing court, but for all versions of the search engine worldwide, including in locations where the content at issue is lawful, may limit the content we can show to our users and impose significant operational burdens. The Supreme Court of Canada issued such a decision against Google in June 2017, and others could treat its decision as persuasive. With respect to the 'right to be forgotten,' a follow-up case of the CJEU on September 24, 2019 ruled that a search engine operator is not required to remove links from all versions of the search engine worldwide, but the court also noted in some cases, removal of links from all versions of the search engine available from the EU (including non-EU specific versions) may be required. The introduction of new businesses, products, services, and technologies, our activities in certain jurisdictions, or other actions we take may subject us to additional laws and regulations. The costs of compliance with these laws and regulations are high and are likely to increase in the future. Any failure on our part to comply with laws and regulations can result in negative publicity and diversion of management time and effort and may subject us to significant liabilities and other penalties. We are subject to claims, suits, government investigations, and other proceedings that may harm our business, financial condition, and operating results. We are subject to claims, suits, and government investigations involving competition, intellectual property, data privacy

and security, consumer protection, tax, labor and employment, commercial disputes, content generated by our users, goods and services offered by advertisers or publishers using our platforms, and other matters. Due to our manufacturing and sale of an expanded suite of products, including hardware as well as Google Cloud offerings, we may also be subject to a variety of claims including product warranty, product liability, and consumer protection claims related to product defects, among other litigation. We may also be subject to claims involving health and safety, hazardous materials usage, other environmental impacts, or service disruptions or failures. Any of these types of legal proceedings can have an adverse effect on us because of legal costs, diversion of management resources, negative publicity and other factors. Determining reserves for our pending litigation is a complex, fact-intensive process that requires significant judgment. The resolution of one or more such proceedings has resulted in, and may in the future result in, additional substantial fines, penalties, injunctions, and other sanctions that could harm our business, financial condition, and operating results. We may be subject to legal liability associated with providing online services or content. Our products and services let users exchange information, advertise products and services, conduct business, and engage in various online activities. We also place advertisements displayed on other companies' websites, and we offer third-party products, services, and/or content. The law relating to the liability of online service providers for others' activities on their services is still somewhat unsettled both within the U.S. and internationally. Claims have been brought against us for defamation, negligence, breaches of contract, copyright and trademark infringement, unfair competition, unlawful activity, torts, fraud, or other legal theories based on the nature and content of information available on or via our services.

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We may be subject to claims by virtue of our involvement in hosting, transmitting, marketing, branding, or providing access to content created by third parties. Defense of any such actions could be costly and involve significant time and attention of our management and other resources, may result in monetary liabilities or penalties, and may require us to change our business in an adverse manner. Privacy and data protection regulations are complex and rapidly evolving areas. Adverse interpretations of these laws could harm our business, reputation, financial condition, and operating results. Authorities around the world have adopted and are considering a number of legislative and regulatory proposals concerning data protection and limits on encryption of user data. Adverse legal rulings, legislation, or regulation could result in fines and orders requiring that we change our data practices, which could have an adverse effect on our ability to provide services, harming our

business operations. Complying with these evolving laws could result in substantial costs and harm the quality of our products and services, negatively affecting our business. Recent legal developments in Europe have created compliance uncertainty regarding transfers of personal data from Europe to the United States. For example, the General Data Protection Regulation (GDPR) applies to all of our activities conducted from an establishment in the EU or related to products and services that we offer to EU users or customers, or the monitoring of their behavior in the EU. The GDPR creates a range of new compliance obligations. Ensuring compliance with the GDPR is an ongoing commitment that involves substantial costs, and despite our efforts, governmental authorities or others have asserted and may continue to assert that our business practices fail to comply with its requirements. If our operations are found to violate GDPR requirements, we may incur substantial fines, have to change our business practices, and face reputational harm, any of which could have a material adverse effect on our business. In particular, serious breaches of the GDPR can result in administrative fines of up to 4% of annual worldwide revenues. Fines of up to 2% of annual worldwide revenues can be levied for other specified violations. The EU-U.S. and the Swiss-U.S. Privacy Shield frameworks allow U.S. companies that self-certify to the U.S. Department of Commerce and publicly commit to comply with specified requirements to import personal data from the EU and Switzerland. However, these frameworks face a number of legal challenges and their validity remains subject to legal, regulatory, and political developments in both Europe and the U.S. The potential invalidation of data transfer mechanisms could have a significant adverse impact on our ability to process and transfer personal data outside of the EEA. These developments create some uncertainty, and compliance obligations could cause us to incur costs or harm the operations of our products and services in ways that harm our business. We face, and may continue to face intellectual property and other claims that could be costly to defend, result in significant damage awards or other costs (including indemnification awards), and limit our ability to use certain technologies in the future. We, like other internet, technology and media companies, hold large numbers of patents, copyrights, trademarks, and trade secrets and are frequently subject to litigation based on allegations of infringement or other violations of intellectual property rights. In addition, patent-holding companies may frequently seek to generate income from patents they have obtained by bringing claims against us. As we have grown, the number of intellectual property claims against us has increased and may continue to increase as we develop new products, services, and technologies. We have had patent, copyright, trade secret, and trademark infringement lawsuits filed against us claiming that certain of our products, services, and technologies infringe the intellectual

property rights of others. Other parties have also sought broad injunctive relief against us by filing claims in U.S. and international courts and the U.S. International Trade Commission (ITC) for exclusion and cease-and-desist orders, which could limit our ability to sell our products or services in the U.S. or elsewhere if our products or services or those of our customers or suppliers are found to infringe the intellectual property subject to the claims. Adverse results in any of these lawsuits may include awards of monetary damages, costly royalty or licensing agreements (if licenses are available at all), or orders preventing us from offering certain features, functionalities, products, or services. They may also cause us to change our business practices and require development of non-infringing products, services, or technologies, which could result in a loss of revenues for us and otherwise harm our business. Many of our agreements with our customers and partners, including certain suppliers, require us to defend against certain intellectual property infringement claims and in some cases indemnify them for certain intellectual property infringement claims against them, which could result in increased costs for defending such claims or significant damages if there were an adverse ruling in any such claims. Such customers and partners may also discontinue the use of our products, services, and technologies, as a result of injunctions or otherwise, which could result in loss of revenues and adversely affect our business. Moreover, intellectual property indemnities provided to us by our suppliers, when obtainable, may not cover all damages and losses suffered by us and our customers arising from intellectual property

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infringement claims. Furthermore, in connection with our divestitures, we have agreed, and may in the future agree, to provide indemnification for certain potential liabilities, including those associated with intellectual property claims. Regardless of their merits, intellectual property claims are often time consuming and expensive to litigate or settle. To the extent such claims are successful, they may harm our business, including our product and service offerings, financial condition, or operating results. Risks Related to Ownership of our Stock We cannot guarantee that any share repurchase program will be fully consummated or that any share repurchase program will enhance long-term stockholder value, and share repurchases could increase the volatility of the price of our stock and could diminish our cash reserves. In January 2018, January 2019, and July 2019, the board of directors of Alphabet authorized the company to repurchase up to $8.6 billion, $12.5 billion, and $25.0 billion of its Class C capital stock, respectively. Share repurchases pursuant to the January 2018 and January 2019 authorizations were completed in 2019. As of December 31, 2019, $20.8 billion remains available for repurchase. Our repurchase program does not have an

expiration date and does not obligate Alphabet to repurchase any specific dollar amount or to acquire any specific number of shares. Our share repurchase program could affect the price of our stock and increase volatility and may be suspended or terminated at any time, which may result in a decrease in the trading price of our stock. The concentration of our stock ownership limits our stockholders' ability to influence corporate matters. Our Class B common stock has 10 votes per share, our Class A common stock has one vote per share, and our Class C capital stock has no voting rights. As of December 31, 2019, Larry Page and Sergey Brin beneficially owned approximately 84.3% of our outstanding Class B common stock, which represented approximately 51.2% of the voting power of our outstanding common stock. Through their stock ownership, Larry and Sergey have significant influence over all matters requiring stockholder approval, including the election of directors and significant corporate transactions, such as a merger or other sale of our company or our assets, for the foreseeable future. In addition, because our Class C capital stock carries no voting rights (except as required by applicable law), the issuance of the Class C capital stock, including in future stock-based acquisition transactions and to fund employee equity incentive programs, could continue Larry and Sergey's current relative voting power and their ability to elect all of our directors and to determine the outcome of most matters submitted to a vote of our stockholders. This concentrated control limits or severely restricts other stockholders' ability to influence corporate matters and we may take actions that some of our stockholders do not view as beneficial, which could reduce the market price of our Class A common stock and our Class C capital stock. Provisions in our charter documents and under Delaware law could discourage a takeover that stockholders may consider favorable. Provisions in Alphabet's certificate of incorporation and bylaws may have the effect of delaying or preventing a change of control or changes in our management. These provisions include the following: • Our certificate of incorporation provides for a tri-class capital stock structure. As a result of this structure, Larry and Sergey have significant influence over all matters requiring stockholder approval, including the election of directors and significant corporate transactions, such as a merger or other sale of our company or our assets. This concentrated control could discourage others from initiating any potential merger, takeover, or other change of control transaction that other stockholders may view as beneficial. As noted above, the issuance of the Class C capital stock could have the effect of continuing the influence of Larry and Sergey. • Our board of directors has the right to elect directors to fill a vacancy created by the expansion of the board of directors or the resignation, death, or removal of a director, which prevents stockholders from being able to fill vacancies on our board of directors. • Our stockholders

may not act by written consent. As a result, a holder, or holders, controlling a majority of our capital stock would not be able to take certain actions without holding a stockholders' meeting. • Our certificate of incorporation prohibits cumulative voting in the election of directors. This limits the ability of minority stockholders to elect director candidates. • Stockholders must provide advance notice to nominate individuals for election to the board of directors or to propose matters that can be acted upon at a stockholders' meeting. These provisions may discourage or deter a potential acquirer from conducting a solicitation of proxies to elect the acquirer's own slate of directors or otherwise attempting to obtain control of our company.

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• Our board of directors may issue, without stockholder approval, shares of undesignated preferred stock. The ability to issue undesignated preferred stock makes it possible for our board of directors to issue preferred stock with voting or other rights or preferences that could impede the success of any attempt to acquire us. As a Delaware corporation, we are also subject to certain Delaware anti-takeover provisions. Under Delaware law, a corporation may not engage in a business combination with any holder of 15% or more of its outstanding voting stock unless the holder has held the stock for three years or, among other things, the board of directors has approved the transaction. Our board of directors could rely on Delaware law to prevent or delay an acquisition of us. General Risks Our operating results may fluctuate, which makes our results difficult to predict and could cause our results to fall short of expectations. Our operating results may fluctuate as a result of a number of factors, many outside of our control. As a result, comparing our operating results on a period-to-period basis may not be meaningful, and you should not rely on our past results as an indication of our future performance. Our quarterly, year-to-date, and annual expenses as a percentage of our revenues may differ significantly from our historical rates. Our operating results in future quarters may fall below expectations. Any of these events could cause our stock price to fall. Each of the risk factors listed in this section in addition to the following factors may affect our operating results: • Our ability to continue to attract and retain users and customers to our products and services. • Our ability to attract user and/or customer adoption of, and generate significant revenues from, new products, services, and technologies in which we have invested considerable time and resources. • Our ability to monetize traffic on Google properties and our Google Network Members' properties across various devices. • Revenue fluctuations caused by changes in device mix, geographic mix, ongoing product and policy changes, product mix, and property mix. • The amount of revenues and expenses generated and

incurred in currencies other than U.S. dollars, and our ability to manage the resulting risk through our foreign exchange risk management program. • The amount and timing of operating costs and expenses and capital expenditures related to the maintenance and expansion of our businesses, operations, and infrastructure. • Our focus on long-term goals over short-term results. • The results of our acquisitions, divestitures, and our investments in risky projects, including new businesses, products, services, and technologies. • Our ability to keep our products and services operational at a reasonable cost and without service interruptions. • The seasonal fluctuations in internet usage, advertising spending, and underlying business trends such as traditional retail seasonality. Our rapid growth has tended to mask the cyclicality and seasonality of our business. As our growth rate has slowed, the cyclicality and seasonality in our business has become more pronounced and caused our operating results to fluctuate. • Geopolitical events, including trade disputes. • Changes in global business or macroeconomic conditions. Because our businesses are changing and evolving, our historical operating results may not be useful to you in predicting our future operating results. Acquisitions, joint ventures, investments, and divestitures could result in operating difficulties, dilution, and other consequences that may harm our business, financial condition, and operating results. Acquisitions, joint ventures, investments and divestitures are important elements of our overall corporate strategy and use of capital, and these transactions could be material to our financial condition and operating results. We expect to continue to evaluate and enter into discussions regarding a wide array of potential strategic transactions, which could create unforeseen operating difficulties and expenditures. Some of the areas where we face risks include: • Diversion of management time and focus from operating our business to challenges related to acquisitions and other strategic transactions. • Failure to successfully integrate and further develop the acquired business or technology.

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• Implementation or remediation of controls, procedures, and policies at the acquired company. • Integration of the acquired company's accounting, human resource, and other administrative systems, and coordination of product, engineering, and sales and marketing functions. • Transition of operations, users, and customers onto our existing platforms. • Failure to obtain required approvals on a timely basis, if at all, from governmental authorities, or conditions placed upon approval that could, among other things, delay or prevent us from completing a transaction, or otherwise restrict our ability to realize the expected financial or strategic goals of a transaction. • In the case of foreign acquisitions, the need to integrate operations across different cultures and languages and to address

the particular economic, currency, political, and regulatory risks associated with specific countries. • Cultural challenges associated with integrating employees from the acquired company into our organization, and retention of employees from the businesses we acquire. • Liability for activities of the acquired company before the acquisition, including patent and trademark infringement claims, data privacy and security issues, violations of laws, commercial disputes, tax liabilities, and other known and unknown liabilities. • Litigation or other claims in connection with the acquired company, including claims from terminated employees, customers, former stockholders, or other third parties. Our failure to address these risks or other problems encountered in connection with our past or future acquisitions and other strategic transactions could cause us to fail to realize their anticipated benefits, incur unanticipated liabilities, and harm our business generally. Our acquisitions and other strategic transactions could also result in dilutive issuances of our equity securities, the incurrence of debt, contingent liabilities, or amortization expenses, or impairment of goodwill and/or purchased long-lived assets, and restructuring charges, any of which could harm our financial condition or operating results. Also, the anticipated benefits or value of our acquisitions and other strategic transactions may not materialize. In connection with our divestitures, we have agreed, and may in the future agree, to provide indemnification for certain potential liabilities, which may harm our financial condition or operating results. If we were to lose the services of key personnel, we may not be able to execute our business strategy. Our future success depends in large part upon the continued service of key members of our senior management team. For instance, Sundar Pichai is critical to the overall management of Alphabet and its subsidiaries and plays an important role in the development of our technology. He also plays a key role in maintaining our culture and setting our strategic direction. All of our executive officers and key employees are at-will employees, and we do not maintain any key-person life insurance policies. The loss of key personnel could seriously harm our business. We rely on highly skilled personnel and, if we are unable to retain or motivate key personnel, hire qualified personnel, or maintain our corporate culture, we may not be able to grow effectively. Our performance largely depends on the talents and efforts of highly skilled individuals. Our future success depends on our continuing ability to identify, hire, develop, motivate, and retain highly skilled personnel for all areas of our organization. Competition in our industry for qualified employees is intense, and certain of our competitors have directly targeted our employees. In addition, our compensation arrangements, such as our equity award programs, may not always be successful in attracting new employees and retaining and motivating our existing employees. Our continued ability to compete effectively depends on our ability

to attract new employees and to retain and motivate our existing employees. In addition, we believe that our corporate culture fosters innovation, creativity, and teamwork. As our organization grows, and we are required to implement more complex organizational management structures, particularly in light of our holding company structure, adverse changes to our corporate culture could harm our business operations. In preparing our financial statements, we incorporate valuation methodologies that are subjective in nature and valuations may fluctuate over time. We measure certain of our non-marketable equity and debt investments, certain other instruments including stock-based compensation awards settled in the stock of certain Other Bets, and certain assets and liabilities acquired in a business combination, at fair value on a nonrecurring basis. The determination of fair value involves use of appropriate valuation methods and certain unobservable inputs, require management judgment and estimation, and may change over time.

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As it relates to our non-marketable investments, the market values can be negatively affected by liquidity, credit deterioration or losses, performance and financial results of the underlying companies, foreign exchange rates, changes in interest rates, including changes that may result from the implementation of new benchmark rates that replace LIBOR, the effect of new or changing regulations, the stock market in general, or other factors. Since January 2018, we adjust the carrying value of our non-marketable equity investments to fair value for observable transactions of identical or similar investments of the same issuer or for impairments. All gains and losses on non-marketable equity securities, realized and unrealized, are recognized in other income (expense), which increases the volatility of our other income (expense). As a result of these factors, the value or liquidity of our cash equivalents, as well as our marketable and non-marketable securities could decline and result in a material impairment, which could materially adversely affect our financial condition and operating results. We could be subject to changes in tax rates, the adoption of new U.S. or international tax legislation, or exposure to additional tax liabilities. Our future income taxes could be negatively affected by earnings being lower than anticipated in jurisdictions that have lower statutory tax rates and higher than anticipated in jurisdictions that have higher statutory tax rates, the net gains and losses recognized by legal entities on certain hedges and related hedged intercompany and other transactions under our foreign exchange risk management program, changes in the valuation of our deferred tax assets or liabilities, or changes in tax laws, regulations, or accounting principles (including changes in the interpretation of existing laws), as well as certain discrete items. In addition, we are

subject to regular review and audit by both domestic and foreign tax authorities. As a result, we have received, and may in the future receive, assessments in multiple jurisdictions, including in Europe, on various tax-related assertions, such as transfer-pricing adjustments or permanent-establishment claims. Any adverse outcome of such a review or audit could have a negative effect on our operating results and financial condition and could require us to change our business practices in a manner adverse to our business. It may also subject us to additional litigation and regulatory inquiries, resulting in the diversion of management's time and attention. In addition, the determination of our worldwide provision for income taxes and other tax liabilities requires significant judgment, and there are many transactions and calculations for which the ultimate tax determination is uncertain. Although we believe our estimates are reasonable, the ultimate tax outcome may differ from the amounts recorded in our financial statements and may materially affect our financial results in the period or periods for which such determination is made. Furthermore, due to shifting economic and political conditions, tax policies, laws, or rates in various jurisdictions may be subject to significant changes in ways that impair our financial results. In particular, France, Italy, and other countries have enacted or are considering digital services taxes, which could lead to inconsistent and potentially overlapping international tax regimes. The Organization for Economic Cooperation and Development recently released a proposal relating to its initiative for modernizing international tax rules, with the goal of having different countries enact legislation to implement a modernized and aligned international tax framework, but there can be no guarantee that this will occur. The trading price for our Class A common stock and non-voting Class C capital stock may continue to be volatile. The trading price of our stock has at times experienced substantial price volatility and may continue to be volatile. For example, from January 1, 2019 through December 31, 2019, the closing price of our Class A common stock ranged from $1,025.47 per share to $1,362.47 per share, and the closing price of our Class C capital stock ranged from $1,016.06 to $1,361.17 per share. In addition to the factors discussed in this report, the trading price of our Class A common stock and Class C capital stock may fluctuate widely in response to various factors, many of which are beyond our control, including, among others: • Quarterly variations in our operating results or those of our competitors. • Announcements by us or our competitors of acquisitions, divestitures, investments, new products, significant contracts, commercial relationships, or capital commitments. • Recommendations by securities analysts or changes in earnings estimates. • Announcements about our earnings that are not in line with analyst expectations, the risk of which is

enhanced because it is our policy not to give guidance on earnings. • Announcements by our competitors of their earnings that are not in line with analyst expectations.

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• Commentary by industry and market professionals about our products, strategies, and other matters affecting our business and results, regardless of its accuracy. • The volume of shares of Class A common stock and Class C capital stock available for public sale. • Sales of Class A common stock and Class C capital stock by us or by our stockholders (including sales by our directors, executive officers, and other employees). • Short sales, hedging, and other derivative transactions on shares of our Class A common stock and Class C capital stock. • The perceived values of Class A common stock and Class C capital stock relative to one another. • Any share repurchase program. In addition, the stock market in general, which can be affected by various factors, including overall economic and political conditions, and the market for technology companies in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of those companies. These broad market and industry factors may harm the market price of our Class A common stock and our Class C capital stock, regardless of our actual operating performance.

C3.1 Management's discussion and analysis of financial condition and results of operations - alphabet 2020 10-K filing

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS Please read the following discussion and analysis of our financial condition and results of operations together with our consolidated financial statements and related notes included under Part II, Item 8 of this Annual Report on Form 10-K. We have omitted discussion of 2017 results where it would be redundant to the discussion previously included in Part II, Item 7 of our 2018 Annual Report on Form 10-K, as amended. Trends in Our Business The following trends have contributed to the results of our consolidated operations, and we anticipate that they will continue to affect our future results: •Users' behaviors and advertising continue to shift online as the digital economy evolves. The continuing shift from an offline to online world has contributed to the growth of our business since inception, contributing to revenue growth, and we expect that this online shift will continue to benefit our business. •Users are increasingly using diverse devices and modalities to access our products and services, and our advertising revenues are increasingly coming from new formats. Our users are accessing the Internet via diverse devices and modalities, such as smartphones, wearables and smart home devices,

and want to feel connected no matter where they are or what they are doing. We seek to expand our products and services to stay in front of these trends in order to maintain and grow our business. We generate our advertising revenues increasingly from different channels, including mobile, and newer advertising formats, and the margins from the advertising revenues from these channels and newer products have generally been lower than those from traditional desktop search. Additionally, as the market for a particular device type or modality matures our revenues may be affected. For example, growth in the global smartphone market has slowed due to various factors, including increased market saturation in developed countries, which can affect our mobile advertising revenue growth rates. We expect TAC paid to our distribution partners to increase as our revenues grow and to be affected by changes in device mix; geographic mix; partner mix; partner agreement terms; and the percentage of queries channeled through paid access points. We expect these trends to continue to put pressure on our overall margins and affect our revenue growth rates. •As online advertising evolves, we continue to expand our product offerings which may affect our monetization. As interactions between users and advertisers change and as online user behavior evolves, we continue to expand and evolve our product offerings to serve their changing needs. Over time, we expect our monetization trends to fluctuate. For example, we have seen an increase in YouTube engagement ads, which monetize at a lower rate than traditional search ads. •As users in developing economies increasingly come online, our revenues from international markets continue to increase and movements in foreign exchange rates affect such revenues. The shift to online, as well as the advent of the multi-device world, has brought opportunities outside of the U.S., including in emerging markets, and we continue to develop localized versions of our products and relevant advertising programs useful to our users in these markets. This has led to a trend of increased revenues from international markets over time and we expect that our results will continue to be affected by our performance in these markets, particularly as low-cost mobile devices become more available. This trend could impact our margins as developing markets initially monetize at a lower rate than more mature markets. Our international revenues represent a significant portion of our revenues and are subject to fluctuations in foreign currency exchange rates relative to the U.S. dollar. While we have a foreign exchange risk management program designed to reduce our exposure to these fluctuations, this program does not fully offset their effect on our revenues and earnings.

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•The portion of our revenues that we derive from non-advertising revenues is increasing and may affect margins. Non-advertising revenues have grown over time. We expect this

trend to continue as we focus on expanding our offerings to our users through products and services like Google Cloud, Google Play, hardware products, and YouTube subscriptions. Across these initiatives, we currently derive non-advertising revenues primarily from sales of apps, in-app purchases, digital content products, and hardware; and licensing and service fees, including fees received for Google Cloud offerings and subscription and other services. The margins on these revenues vary significantly and may be lower than the margins on our advertising revenues. A number of our Other Bets initiatives are in their initial development stages, and as such, the sources of revenues from these businesses could change over time and the revenues could be volatile. As we continue to serve our users and expand our businesses, we will invest heavily in operating and capital expenditures. We continue to make significant R&D investments in areas of strategic focus such as advertising, cloud, machine learning, and search, as well as in new products and services. In addition, our capital expenditures have grown over the last several years. We expect this trend to continue in the long term as we invest heavily in land and buildings for data centers and offices, and information technology infrastructure, which includes servers and network equipment. In addition, acquisitions remain an important part of our strategy and use of capital, and we expect to continue to spend cash on acquisitions and other investments. These acquisitions generally enhance the breadth and depth of our offerings, as well as expand our expertise in engineering and other functional areas. • Our employees are critical to our success and we expect to continue investing in them. Our employees are among our best assets and are critical for our continued success. We expect to continue hiring talented employees around the globe and to provide competitive compensation programs to our employees. Executive Overview of Results Below are our key financial results for the fiscal year ended December 31, 2019 (consolidated unless otherwise noted): • Revenues of $161.9 billion and revenue growth of 18% year over year, constant currency revenue growth of 20% year over year. • Google segment revenues of $160.7 billion with revenue growth of 18% year over year and Other Bets revenues of $659 million with revenue growth of 11% year over year. • Revenues from the United States, EMEA, APAC, and Other Americas were $74.8 billion, $50.6 billion, $26.9 billion, and $9.0 billion, respectively. Cost of revenues was $71.9 billion, consisting of TAC of $30.1 billion and other cost of revenues of $41.8 billion. Our TAC as a percentage of advertising revenues (TAC rate) was 22.3%. Operating expenses (excluding cost of revenues) were $55.7 billion. Income from operations was $34.2 billion. Other income (expense), net, was $5.4 billion. Effective tax rate was 13%. Net income was $34.3 billion with diluted net income per share of $49.16. Operating cash flow was $54.5 billion. Capital expenditures were $23.5 billion. Number of employees

was 118,899 as of December 31, 2019. The majority of new hires during the year were engineers and product managers. By product area, the largest headcount additions were in Google Cloud and Search.

C3.2 Quantitative and qualitative disclosures about market risk - alphabet 2020 10-K filing

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK We are exposed to financial market risks, including changes in foreign currency exchange rates, interest rates, and equity investment risks. Foreign Currency Exchange Risk We transact business globally in multiple currencies. Our international revenues, as well as costs and expenses denominated in foreign currencies, expose us to the risk of fluctuations in foreign currency exchange rates against the U.S. dollar. Principal currencies hedged included the Australian dollar, British pound, Canadian dollar, Euro and Japanese yen. For the purpose of analyzing foreign currency exchange risk, we considered the historical trends in foreign currency exchange rates and determined that it was reasonably possible that adverse changes in exchange rates of 10% could be experienced in the near term. We use foreign exchange forward contracts to offset the foreign exchange risk on our assets and liabilities denominated in currencies other than the local currency of the subsidiary. These forward contracts reduce, but do not entirely eliminate, the effect of foreign currency exchange rate movements on our assets and liabilities. The foreign

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currency gains and losses on the assets and liabilities are recorded in other income (expense), net, which are offset by the gains and losses on the forward contracts. If an adverse 10% foreign currency exchange rate change was applied to total monetary assets and liabilities denominated in currencies other than the local currencies at the balance sheet dates, it would have resulted in an adverse effect on income before income taxes of approximately $1 million and $8 million as of December 31, 2018 and 2019, respectively. The adverse effect as of December 31, 2018 and 2019 is after consideration of the offsetting effect of approximately $374 million and $662 million, respectively, from foreign exchange contracts in place for the years ended December 31, 2018 and 2019. We use foreign currency forwards and option contracts, including collars (an option strategy comprised of a combination of purchased and written options) to protect our forecasted U.S. dollar-equivalent earnings from changes in foreign currency exchange rates. When the U.S. dollar strengthens, gains from foreign currency options and forwards reduce the foreign currency losses related to our earnings. When the U.S. dollar weakens, losses from foreign currency collars and forwards

offset the foreign currency gains related to our earnings. These hedging contracts reduce, but do not entirely eliminate, the effect of foreign currency exchange rate movements. We designate these contracts as cash flow hedges for accounting purposes. We reflect the gains or losses of foreign currency spot rate changes as a component of AOCI and subsequently reclassify them into revenues to offset the hedged exposures as they occur. If the U.S. dollar weakened by 10% as of December 31, 2018 and 2019, the amount recorded in AOCI related to our foreign exchange contracts before tax effect would have been approximately $772 million and $1.1 billion lower as of December 31, 2018 and 2019, respectively. The change in the value recorded in AOCI would be expected to offset a corresponding foreign currency change in forecasted hedged revenues when recognized. We use foreign exchange forward contracts designated as net investment hedges to hedge the foreign currency risks related to our investment in foreign subsidiaries. These forward contracts serve to offset the foreign currency translation risk from our foreign operations. If the U.S. dollar weakened by 10%, the amount recorded in cumulative translation adjustment (CTA) within AOCI related to our net investment hedge would have been approximately $635 million and $936 million lower as of December 31, 2018 and 2019, respectively. The change in value recorded in CTA would be expected to offset a corresponding foreign currency translation gain or loss from our investment in foreign subsidiaries. Interest Rate Risk Our Corporate Treasury investment strategy is to achieve a return that will allow us to preserve capital and maintain liquidity. We invest primarily in debt securities including those of the U.S. government and its agencies, corporate debt securities, mortgage-backed securities, money market and other funds, municipal securities, time deposits, asset backed securities, and debt instruments issued by foreign governments. By policy, we limit the amount of credit exposure to any one issuer. Our investments in both fixed rate and floating rate interest earning securities carry a degree of interest rate risk. Fixed rate securities may have their fair market value adversely affected due to a rise in interest rates, while floating rate securities may produce less income than predicted if interest rates fall. Unrealized gains or losses on our marketable debt securities are primarily due to interest rate fluctuations as a result of higher market interest rates compared to interest rates at the time of purchase. We account for both fixed and variable rate securities at fair value with gains and losses recorded in AOCI until the securities are sold. We use value-at-risk (VaR) analysis to determine the potential effect of fluctuations in interest rates on the value of our marketable debt security portfolio. The VaR is the expected loss in fair value, for a given confidence interval, for our investment portfolio due to adverse movements in interest rates. We use a variance/covariance VaR model with 95% confidence interval. The estimated one-day loss

in fair value of our marketable debt securities as of December 31, 2018 and 2019 are shown below (in millions):

As of December 31,

12-Month Average As of December 31,

2018

2019

2018

2019 Risk Category - Interest Rate $ 58

$ 104

$ 66

$ 90

Actual future gains and losses associated with our marketable debt security portfolio may differ materially from the sensitivity analyses performed as of December 31, 2018 and 2019 due to the inherent limitations associated with predicting the timing and amount of changes in interest rates and our actual exposures and positions. VaR analysis is not intended to represent actual losses but is used as a risk estimation.

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Equity Investment Risk Our marketable and non-marketable equity securities are subject to a wide variety of market-related risks that could substantially reduce or increase the fair value of our holdings. Our marketable equity securities are publicly traded stocks or funds and our non-marketable equity securities are investments in privately held companies, some of which are in the startup or development stages. We record our marketable equity securities not accounted for under the equity method at fair value based on readily determinable market values, of which publicly traded stocks and mutual funds are subject to market price volatility, and represent $3.3 billion of our investments as of December 31, 2019. A hypothetical adverse price change of 10%, which could be experienced in the near term, would decrease the fair value of our marketable equity securities by $330 million. Our non-marketable equity securities not accounted for under the equity method are adjusted to fair value for observable transactions for identical or similar investments of the same issuer or impairment (referred to as the measurement alternative). The fair value is measured at the time of the observable transaction, which is not necessarily an indication of the current fair value as of the balance sheet date. These investments, especially those that are in the early stages, are inherently risky because the technologies or products these companies have under development are typically in the early phases and may never materialize and they may experience a decline in financial condition, which could result in a

loss of a substantial part of our investment in these companies. The success of our investment in any private company is also typically dependent on the likelihood of our ability to realize appreciation in the value of our investments through liquidity events such as public offerings, acquisitions, private sales or other favorable market events. As of December 31, 2019, the carrying value of our non-marketable equity securities, which were accounted for under the measurement alternative, was $11.4 billion. Valuations of our equity investments in private companies are inherently more complex due to the lack of readily available market data. Volatility in the global economic climate and financial markets could result in a significant impairment charge on our non-marketable equity securities. The carrying values of our equity method investments generally do not fluctuate based on market price changes, however these investments could be impaired if the carrying value exceeds the fair value. For further information about our equity investments, please refer to Note 1 and Note 3 of the Notes to Consolidated Financial Statements included in Part II of this Annual Report on Form 10-K.

D4 Risk Factors alphabet 2021 10-K filing

ITEM 1A.RISK FACTORS Our operations and financial results are subject to various risks and uncertainties, including but not limited to those described below, which could harm our business, reputation, financial condition, and operating results. Risks Specific to our Company We generate a significant portion of our revenues from advertising, and reduced spending by advertisers, a loss of partners, or new and existing technologies that block ads online and/or affect our ability to customize ads could harm our business. We generated over 80% of total revenues from the display of ads online in 2020. Many of our advertisers, companies that distribute our products and services, digital publishers, and content providers can terminate their contracts with us at any time. These partners may not continue to do business with us if we do not create more value (such as increased numbers of users or customers, new sales leads, increased brand awareness, or more effective monetization) than their available alternatives. Changes to our advertising policies and data privacy practices, as well as changes to other companies' advertising and/or data privacy practices may affect the advertising that we are able to provide, which could harm our business. In addition, technologies have been developed that make customized ads more difficult or that block the display of ads altogether and some providers of online services have integrated technologies that could potentially impair the availability and functionality

of third-party digital advertising. Failing to provide superior value or deliver advertisements effectively and competitively could harm our reputation, financial condition, and operating results. In addition, expenditures by advertisers tend to be cyclical, reflecting overall economic conditions and budgeting and buying patterns. Adverse macroeconomic conditions, including COVID-19 and its effects on the global economy (as discussed in greater detail in our COVID-19 risk factor under 'General Risks' below), have impacted the demand for advertising and resulted in fluctuations in the amounts our advertisers spend on advertising, and could have an adverse impact on such demand and spend, which could harm our financial condition and operating results. We face intense competition. If we do not continue to innovate and provide products and services that are useful to users, we may not remain competitive, which could harm our business and operating results. Our business environment is rapidly evolving and intensely competitive. Our businesses face changing technologies, shifting user needs, and frequent introductions of rival products and services. To compete successfully, we must accurately anticipate technology developments and deliver innovative, relevant and useful products, services, and technologies in a timely manner. As our businesses evolve, the competitive pressure to innovate will encompass a wider range of products and services. We must continue to invest significant resources in research and development, including through acquisitions, in order to enhance our technology and new and existing products and services. We have many competitors in different industries. Our current and potential domestic and international competitors range from large and established companies to emerging start-ups. Some competitors have longer operating histories and well established relationships in various sectors. They can use their experience and resources in ways that could affect our competitive position, including by making acquisitions, continuing to invest heavily in research and development and in talent, aggressively initiating intellectual property claims (whether or not meritorious), and continuing to compete aggressively for users, advertisers, customers, and content providers. Further, discrepancies in enforcement of existing laws may enable our lesser known competitors to aggressively interpret those laws without commensurate scrutiny, thereby affording them competitive advantages. Our competitors may also be able to innovate and provide products and services faster than we can or may foresee the need for products and services before us. Our operating results may also suffer if our products and services are not responsive to the needs of our users, advertisers, publishers, customers, and content providers. As technologies continue to develop, our competitors may be able to offer experiences that are, or that are seen to be, substantially similar to or better than ours. This 10 Table of Contents Alphabet Inc.

may force us to compete in different ways and expend significant resources in order to remain competitive. If our competitors are more successful than we are in developing compelling products or in attracting and retaining users, advertisers, publishers, customers, and content providers, our operating results could be harmed. Our ongoing investment in new businesses, products, services, and technologies is inherently risky, and could disrupt our current operations and harm our financial condition and operating results. We have invested and expect to continue to invest in new businesses, products, services, and technologies. The investments that we are making across Google Services, Google Cloud and Other Bets reflect our ongoing efforts to innovate and provide products and services that are useful to users, advertisers, publishers, customers, and content providers. Our investments in Google Services, Google Cloud and Other Bets span a wide range of industries beyond online advertising. Such investments ultimately may not be commercially viable or may not result in an adequate return of capital and, in pursuing new strategies, we may incur unanticipated liabilities. These endeavors may involve significant risks and uncertainties, including diversion of management resources and, with respect to Other Bets, the use of alternative investment, governance, or compensation structures that may fail to adequately align incentives across the company or otherwise accomplish their objectives. Within Google Services, we continue to invest heavily in hardware, including our smartphones and home devices, which is a highly competitive market with frequent introduction of new products and services, rapid adoption of technological advancements by competitors, short product life cycles, evolving industry standards, continual improvement in product price and performance characteristics, and price and feature sensitivity on the part of consumers and businesses. There can be no assurance we will be able to provide hardware that competes effectively. Within Google Cloud, we devote significant resources to develop and deploy our enterprise-ready cloud services, including Google Cloud Platform and Google Workspace. We are incurring costs to build and maintain infrastructure to support cloud computing services and hire talent, particularly to support and scale our salesforce. At the same time, our competitors are rapidly developing and deploying cloud-based services. Pricing and delivery models are competitive and evolving, and we may not attain sufficient scale and profitability to achieve our business objectives. Within Other Bets, we are investing significantly in the areas of health, life sciences, and transportation, among others. These investment areas face intense competition from large experienced and well-funded competitors and our offerings may not be able to compete effectively or to operate at sufficient levels of profitability. In addition, new and evolving products and

services, including those that use artificial intelligence and machine learning, raise ethical, technological, legal, regulatory, and other challenges, which may negatively affect our brands and demand for our products and services. Because all of these new ventures are inherently risky, no assurance can be given that such strategies and offerings will be successful and will not harm our reputation, financial condition, and operating results. Our revenue growth rate could decline over time, and we anticipate downward pressure on our operating margin in the future. Our revenue growth rate could decline over time as a result of a number of factors, including increasing competition and the continued expansion of our business into a variety of new fields. Changes in device mix, geographic mix, ongoing product and policy changes, product mix, and property mix and an increasing competition for advertising may also affect our advertising revenue growth rate. We may also experience a decline in our revenue growth rate as our revenues increase to higher levels, if there is a decrease in the rate of adoption of our products, services, and technologies, or due to deceleration or decline in demand for devices used to access our services, among other factors. In addition, COVID-19 and its effects on the global economy has impacted and may continue to adversely impact our revenue growth rate (as discussed in greater detail in our COVID-19 risk factor under 'General Risks' below). In addition to a decline in our revenue growth rate, we may also experience downward pressure on our operating margin resulting from a variety of factors, such as the continued expansion of our business into new fields, including products and services such as hardware, Google Cloud, and subscription products, as well as significant investments in Other Bets, all of which may have margins lower than those we generate from advertising. We may also experience downward pressure on our operating margins from increasing regulations, increasing competition and increased costs for many aspects of our business, including within advertising where changes such as device mix, property mix, and partner agreements can affect margin. The margin we earn on revenues generated from our Google Network Members could also decrease in the future if we pay a larger percentage of advertising fees to them. We may also pay increased TAC to our distribution partners as well as increased content acquisition 11 Table of Contents Alphabet Inc.

costs to content providers. We may also face an increase in infrastructure costs, supporting businesses such as Search, Google Cloud, and YouTube. Many of our expenses are less variable in nature and may not correlate to changes in revenues. Due to these factors and the evolving nature of our business, our historical revenue growth rate and historical operating margin may not be indicative of our future performance. Our intellectual property rights are valuable, and any inability to protect them could reduce the

value of our products, services and brands as well as affect our ability to compete. Our patents, trademarks, trade secrets, copyrights, and other intellectual property rights are important assets for us. Various events outside of our control pose a threat to our intellectual property rights, as well as to our products, services, and technologies. For example, effective intellectual property protection may not be available in every country in which our products and services are distributed or made available through the Internet. Also, the efforts we have taken to protect our proprietary rights may not be sufficient or effective. Although we seek to obtain patent protection for our innovations, it is possible we may not be able to protect some of these innovations. Moreover, we may not have adequate patent or copyright protection for certain innovations that later turn out to be important. Furthermore, there is always the possibility, despite our efforts, that the scope of the protection gained will be insufficient or that an issued patent may be deemed invalid or unenforceable. We also seek to maintain certain intellectual property as trade secrets. The secrecy of such trade secrets and other sensitive information could be compromised, which could cause us to lose the competitive advantage resulting from these trade secrets. We also face risks associated with our trademarks. For example, there is a risk that the word “Google” could become so commonly used that it becomes synonymous with the word “search.” Some courts have ruled that "Google" is a protectable trademark, but it is possible that other courts, particularly those outside of the United States, may reach a different determination. If this happens, we could lose protection for this trademark, which could result in other people using the word “Google” to refer to their own products, thus diminishing our brand. Any significant impairment of our intellectual property rights could harm our business and our ability to compete. Also, protecting our intellectual property rights is costly and time consuming. Any increase in the unauthorized use of our intellectual property could make it more expensive to do business and harm our operating results. Our business depends on strong brands, and failing to maintain and enhance our brands would hurt our ability to expand our base of users, advertisers, customers, content providers, and other partners. Our strong brands have significantly contributed to the success of our business. Maintaining and enhancing the brands within Google Services, Google Cloud and Other Bets increases our ability to enter new categories and launch new and innovative products that better serve the needs of our users, advertisers, customers, content providers, and other partners. Our brands may be negatively affected by a number of factors, including, among others, reputational issues, third-party content shared on our platforms, data privacy and security issues and developments, and product or technical performance failures. For example, if we fail to appropriately respond to the sharing of

misinformation or objectionable content on our services and/or products or objectionable practices by advertisers, or to otherwise adequately address user concerns, our users may lose confidence in our brands. Furthermore, failure to maintain and enhance equity in our brands may harm our business, financial condition, and operating results. Our success will depend largely on our ability to remain a technology leader and continue to provide high-quality, innovative products and services that are truly useful and play a valuable role in a range of settings. We face a number of manufacturing and supply chain risks that, if not properly managed, could harm our financial condition, operating results, and prospects. We face a number of risks related to manufacturing and supply chain management, which could affect our ability to supply both our products and our internet-based services. We rely on other companies to manufacture many of our finished products, to design certain of our components and parts, and to participate in the distribution of our products and services. Our business could be negatively affected if we are not able to engage these companies with the necessary capabilities or capacity on reasonable terms, or if those we engage fail to meet their obligations (whether due to financial difficulties or other reasons), or make adverse changes in the pricing or other material terms of our arrangements with them. We have experienced and/or may experience supply shortages and price increases driven by raw material, component or part availability, manufacturing capacity, labor shortages, industry allocations, tariffs, trade disputes 12 Table of Contents Alphabet Inc.

and barriers, natural disasters or pandemics (including COVID-19), the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity), and significant changes in the financial or business condition of our suppliers. We have experienced and/or may in the future, experience shortages or other supply chain disruptions that could negatively affect our operations. In addition, some of the components we use in our technical infrastructure and products are available from only one or limited sources, and we may not be able to find replacement vendors on favorable terms in the event of a supply chain disruption. In addition, a significant supply interruption could delay critical data center upgrades or expansions and delay product availability. We may enter into long term contracts for materials and products that commit us to significant terms and conditions. We may be liable for materials and products that are not consumed due to market acceptance, technological change, obsolescences, quality, product recalls, and warranty issues. For instance, because certain of our hardware supply contracts have volume-based pricing or minimum purchase requirements, if the volume of our hardware sales decreases or does not reach projected targets, we could face increased materials and

manufacturing costs or other financial liabilities that could make our products more costly per unit to manufacture and negatively affect our financial results. Furthermore, certain of our competitors may negotiate more favorable contractual terms based on volume and other commitments that may provide them with competitive advantages and may affect our supply. Our products and services may have quality issues resulting from design, manufacturing, or operations. Sometimes, these issues may be caused by components we purchase from other manufacturers or suppliers. If the quality of our products and services does not meet expectations or our products or services are defective, it could harm our reputation, financial condition, and operating results. We require our suppliers and business partners to comply with laws and, where applicable, our company policies, such as the Google Supplier Code of Conduct, regarding workplace and employment practices, data security, environmental compliance and intellectual property licensing, but we do not control them or their practices. Violations of law or unethical business practices could result in supply chain disruptions, canceled orders, harm to key relationships, and damage to our reputation. Their failure to procure necessary license rights to intellectual property, could affect our ability to sell our products or services and expose us to litigation or financial claims. Interruption, interference with, or failure of our complex information technology and communications systems could hurt our ability to effectively provide our products and services, which could harm our reputation, financial condition, and operating results. In addition, complications with the design or implementation of our new global enterprise resource planning system could harm our business and operations. The availability of our products and services and fulfillment of our customer contracts depend on the continuing operation of our information technology and communications systems. Our systems are vulnerable to damage, interference, or interruption from modifications or upgrades, terrorist attacks, natural disasters or pandemics (including COVID-19), the effects of climate change (such as sea level rise, drought, flooding, wildfires, and increased storm severity), power loss, telecommunications failures, computer viruses, ransomware attacks, computer denial of service attacks, phishing schemes, or other attempts to harm or access our systems. Some of our data centers are located in areas with a high risk of major earthquakes or other natural disasters. Our data centers are also subject to break-ins, sabotage, and intentional acts of vandalism, and, in some cases, to potential disruptions resulting from problems experienced by facility operators. Some of our systems are not fully redundant, and disaster recovery planning cannot account for all eventualities. The occurrence of a natural disaster or pandemic (including COVID-19), closure of a facility, or other unanticipated problems at, or impacting, our data centers could result in lengthy

interruptions in our service. In addition, our products and services are highly technical and complex and may contain errors or vulnerabilities, which could result in interruptions in or failure of our services or systems. In addition, we rely extensively on information systems and technology to manage our business and summarize operating results. We are in the process of a multi-year implementation of a new ERP system, which will replace much of our existing core financial systems. The ERP system is designed to accurately maintain our financial records, enhance the flow of financial information, improve data management, and provide timely information to our management team. We may not be able to successfully implement the ERP system without experiencing delays, increased costs, and other difficulties. Failure to successfully design and implement the new ERP system as planned could harm our business, financial condition, and operating results. Additionally, if we do not effectively implement the ERP system as planned or the ERP system does not operate as intended, the effectiveness of our internal control over financial reporting could be negatively affected. 13 Table of Contents Alphabet Inc.

Our international operations expose us to additional risks that could harm our business, our financial condition, and operating results. Our international operations are significant to our revenues and net income, and we plan to continue to grow internationally. International revenues accounted for approximately 53% of our consolidated revenues in 2020. In addition to risks described elsewhere in this section, our international operations expose us to other risks, including the following: •Restrictions on foreign ownership and investments, and stringent foreign exchange controls that might prevent us from repatriating cash earned in countries outside the U.S. •Import and export requirements, tariffs and other market access barriers that may prevent or impede us from offering products or providing services to a particular market, or that could limit our ability to source assemblies and finished products from a particular market, and may increase our operating costs. •Longer payment cycles in some countries, increased credit risk, and higher levels of payment fraud. •Evolving foreign events, including the effect of the United Kingdom's withdrawal from the European Union, may adversely affect our revenues and could subject us to new regulatory costs and challenges (including the transfer of personal data between the EU and the United Kingdom and new customer requirements), in addition to other adverse effects that we are unable to effectively anticipate. •Anti-corruption laws, such as the U.S. Foreign Corrupt Practices Act, and other local laws prohibiting certain payments to government officials, violations of which could result in civil and criminal penalties. •Uncertainty regarding liability for services and content, including uncertainty as a result

of local laws and lack of legal precedent. •Different employee/employer relationships, existence of works councils and labor unions, and other challenges caused by distance, language, and cultural differences, making it harder to do business in certain jurisdictions. Because we conduct business in currencies other than U.S. dollars but report our financial results in U.S. dollars, we face exposure to fluctuations in foreign currency exchange rates. Although we hedge a portion of our international currency exposure, significant fluctuations in exchange rates between the U.S. dollar and foreign currencies may adversely affect our revenues and earnings, particularly in light of market volatilities due to COVID-19. Hedging programs are also inherently risky and could expose us to additional risks that could harm our financial condition and operating results. Risks Related to our Industry People access the Internet through a variety of platforms and devices that continue to evolve with the advancement of technology and user preferences. If manufacturers and users do not widely adopt versions of our products and services developed for these interfaces, our business could be harmed. People access the Internet through a growing variety of devices such as desktop computers, mobile phones, smartphones, laptops and tablets, video game consoles, voice-activated speakers, wearables, automobiles, and television-streaming devices. Our products and services may be less popular on some interfaces. Each manufacturer or distributor may establish unique technical standards for its devices, and our products and services may not be available or may only be available with limited functionality for our users or our advertisers on these devices as a result. Some manufacturers may also elect not to include our products on their devices. In addition, search queries are increasingly being undertaken via voice-activated speakers, apps, social media or other platforms, which could harm our business. It is hard to predict the challenges we may encounter in adapting our products and services and developing competitive new products and services. We expect to continue to devote significant resources to creating and supporting products and services across multiple platforms and devices. Failing to attract and retain a substantial number of new device manufacturers, suppliers, distributors, developers, and users, or failing to develop products and technologies that work well on new devices and platforms, could harm our business, financial condition, and operating results and ability to capture future business opportunities. Data privacy and security concerns relating to our technology and our practices could damage our reputation, cause us to incur significant liability, and deter current and potential users or customers from using our products and services. Software bugs or defects, security breaches, and attacks on our systems could result in the improper disclosure and use of user data and interference with our users and customers' ability to

use our products and services, harming our business operations and reputation. 14 Table of Contents Alphabet Inc.

Concerns about our practices with regard to the collection, use, disclosure, or security of personal information or other data-privacy-related matters, even if unfounded, could harm our reputation, financial condition, and operating results. Our policies and practices may change over time as expectations regarding privacy and data change. Our products and services involve the storage and transmission of proprietary and other sensitive information, and bugs, theft, misuse, defects, vulnerabilities in our products and services, and security breaches expose us to a risk of loss of this information, improper use and disclosure of such information, litigation, and other potential liability. Systems and control failures, security breaches, failure to comply with our privacy policies, and/or inadvertent disclosure of user data could result in government and legal exposure, seriously harm our reputation and brand and, therefore, our business, and impair our ability to attract and retain users or customers. We expect to continue to expend significant resources to maintain security protections that shield against bugs, theft, misuse, or security vulnerabilities or breaches. We experience cyber attacks and other attempts to gain unauthorized access to our systems on a regular basis. We may experience future security issues, whether due to employee error or malfeasance or system errors or vulnerabilities in our or other parties' systems, which could result in significant legal and financial exposure. Government inquiries and enforcement actions, litigation, and adverse press coverage could harm our business. We may be unable to anticipate or detect attacks or vulnerabilities or implement adequate preventative measures. Attacks and security issues could also compromise trade secrets and other sensitive information, harming our business. While we have dedicated significant resources to privacy and security incident response capabilities, including dedicated worldwide incident response teams, our response process, particularly during times of a natural disaster or pandemic (including COVID-19), may not be adequate, may fail to accurately assess the severity of an incident, may not respond quickly enough, or may fail to sufficiently remediate an incident. As a result, we may suffer significant legal, reputational, or financial exposure, which could harm our business, financial condition, and operating results. Our ongoing investments in safety, security, and content review will likely continue to identify abuse of our platforms and misuse of user data. In addition to our efforts to mitigate cyber attacks, we are making significant investments in safety, security, and content review efforts to combat misuse of our services and unauthorized access to user data by third parties, including investigations and review of platform applications that could access the information of users of our services. As a result of these efforts, we could discover

incidents of unnecessary access to or misuse of user data or other undesirable activity by third parties. We may not discover all such incidents or activity, whether as a result of our data limitations, including our lack of visibility over our encrypted services, the scale of activity on our platform, or other factors, including factors outside of our control such as a natural disaster or pandemic (including COVID-19), and we may be notified of such incidents or activity via third parties. Such incidents and activities may include the use of user data or our systems in a manner inconsistent with our terms, contracts or policies, the existence of false or undesirable user accounts, election interference, improper ad purchases, activities that threaten people's safety on- or offline, or instances of spamming, scraping, or spreading disinformation. We may also be unsuccessful in our efforts to enforce our policies or otherwise remediate any such incidents. Any of the foregoing developments may negatively affect user trust and engagement, harm our reputation and brands, require us to change our business practices in a manner adverse to our business, and adversely affect our business and financial results. Any such developments may also subject us to additional litigation and regulatory inquiries, which could result in monetary penalties and damages, divert management's time and attention, and lead to enhanced regulatory oversight. Problematic content on our platforms, including low-quality user-generated content, web spam, content farms, and other violations of our guidelines could affect the quality of our services, which could damage our reputation and deter our current and potential users from using our products and services. We, like others in the industry, face violations of our content guidelines across our platforms, including sophisticated attempts by bad actors to manipulate our hosting and advertising systems to fraudulently generate revenues, or to otherwise generate traffic that does not represent genuine user interest or intent. While we invest significantly in efforts to promote high-quality and relevant results and to detect and prevent low-quality content and invalid traffic, we may be unable to adequately detect and prevent such abuses or promote high-quality content, particularly during times of a natural disaster or pandemic (including COVID-19). Many websites violate or attempt to violate our guidelines, including by seeking to inappropriately rank higher in search results than our search engine's assessment of their relevance and utility would rank them. Such efforts 15 Table of Contents Alphabet Inc.

(known as "web spam") may affect the quality of content on our platforms and lead them to display false, misleading or undesirable content. Although English-language web spam in our search results has been reduced, and web spam in most other languages is limited, we expect web spammers will continue to seek inappropriate ways to improve their rankings. We continuously combat web spam in our search results, including through

indexing technology that makes it harder for spam-like, less useful web content to rank highly. We also continue to invest in and deploy proprietary technology to detect and prevent web spam from abusing our platforms. We also face other challenges from low-quality and irrelevant content websites, including content farms, which are websites that generate large quantities of low-quality content to help them improve their search rankings. We are continually launching algorithmic changes focused on detecting and preventing abuse from low-quality websites. We also face other challenges on our platforms, including violations of our content guidelines involving incidents such as attempted election interference, activities that threaten the safety and/or well-being of our users on- or offline, and the spreading of disinformation, among other challenges. If we fail to either detect and prevent an increase in problematic content or effectively promote high-quality content, it could hurt our reputation for delivering relevant information or reduce use of our platforms, harming our financial condition or operating results. It may also subject us to litigation and regulatory inquiries, which could result in monetary penalties and damages, divert management's time and attention, and lead to enhanced regulatory oversight. Our business depends on continued and unimpeded access to the Internet by us and our users. Internet access providers may be able to restrict, block, degrade, or charge for access to certain of our products and services, which could lead to additional expenses and the loss of users and advertisers. Our products and services depend on the ability of our users to access the Internet, and certain of our products require significant bandwidth to work effectively. Currently, this access is provided by companies that have significant market power in the broadband and internet access marketplace, including incumbent telephone companies, cable companies, mobile communications companies, and government-owned service providers. Some of these providers have taken, or have stated that they may take measures that could degrade, disrupt, or increase the cost of user access to certain of our products by restricting or prohibiting the use of their infrastructure to support or facilitate our offerings, by charging increased fees to us or our users to provide our offerings, or by providing our competitors preferential access. Some jurisdictions have adopted regulations prohibiting certain forms of discrimination by internet access providers; however, substantial uncertainty exists in the United States and elsewhere regarding such protections. For example, in 2018 the United States Federal Communications Commission repealed net neutrality rules, which could permit internet access providers to restrict, block, degrade, or charge for access to certain of our products and services. In addition, in some jurisdictions, our products and services have been subject to government-initiated restrictions or blockages. COVID-19 has also resulted in quarantines, shelter in place orders, and work from

home directives, all of which have increased demands for internet access and may create access challenges. These could result in a loss of existing users, customers and advertisers, goodwill, and increased costs, and could impair our ability to attract new users, customers and advertisers, thereby harming our business. Risks Related to Laws and Regulations We face increased regulatory scrutiny as well as changes in regulatory conditions, laws and policies governing a wide range of topics that may negatively affect our business. We and other companies in the technology industry face increased regulatory scrutiny, enforcement action, and other proceedings. For instance, the U.S. Department of Justice, joined by a number of state Attorneys General, filed an antitrust complaint against Google on October 20, 2020, alleging that Google violated U.S. antitrust laws relating to Search and Search advertising. Separately, on December 16, 2020, a number of state Attorneys General filed an antitrust complaint against Google in the United States District Court for the Eastern District of Texas, alleging that Google violated U.S. antitrust laws as well as state deceptive trade laws relating to its advertising technology. Various other regulatory agencies in the United States and around the world, including competition enforcers, consumer protection agencies, data protection authorities, grand juries, inter-agency consultative groups, and a range of other governmental bodies have and continue to review our products and services and their compliance with laws and regulations around the world. We continue to cooperate with these investigations. Various laws, regulations, investigations, enforcement lawsuits, and regulatory actions have in the past and may in the future result in substantial fines and penalties, injunctive relief, ongoing auditing and monitoring 16 Table of Contents Alphabet Inc.

obligations, changes to our products and services, alterations to our business models and operations, and collateral litigation, all of which could harm our business, reputation, financial condition, and operating results. Changes in international and local social, political, economic, tax, and regulatory conditions or in laws and policies governing a wide range of topics may increase our cost of doing business, limit our ability to pursue certain business models, offer products or services in certain jurisdictions, or cause us to change our business practices. We have in the past had to alter or withdraw certain products and services as a result of laws or regulations that made them unfeasible, and new laws or regulations, such as the News Media Bargaining Code drafted by the Australian Competition and Consumer Commission currently tabled in parliament, could result in our having to alter or withdraw products and services in the future. These additional costs of doing business, new limitations or changes to our business model or practices could harm our business, reputation, financial condition, and operating results. A variety of new and

existing laws and/or interpretations could harm our business. We are subject to numerous U.S. and foreign laws and regulations covering a wide variety of subject matters. New laws and regulations (or new interpretations or applications of existing laws and regulations in a manner inconsistent with our practices) may make our products and services less useful, limit our ability to pursue certain business models or offer certain products and services, require us to incur substantial costs, expose us to civil or criminal liability, or cause us to change our business practices. These laws and regulations are evolving and involve matters central to our business, including, among others: •New competition laws and related regulations around the world, that can limit certain business practices, and in some cases, create the risk of significant penalties. •Privacy laws, such as the California Consumer Privacy Act of 2018 that came into effect in January of 2020 and the California Privacy Rights Act which will go into effect in 2023, both of which give new data privacy rights to California residents, and SB-327 in California, which regulates the security of data in connection with internet connected devices. •Data protection laws passed by many states within the U.S. and by certain countries regarding notification to data subjects and/or regulators when there is a security breach of personal data. •New laws further restricting the collection, processing and/or sharing of advertising-related data. •Copyright or similar laws around the world, including the EU Directive on Copyright in the Digital Single Market (EUCD) of April 17, 2019, which EU Member States must implement by June 7, 2021; and the News Media Bargaining Code drafted by the Australian Competition and Consumer Commission. These and similar laws that have been adopted or proposed introduce new constraining licensing regimes that could affect our ability to operate. The EUCD and similar laws could increase the liability of some content-sharing services with respect to content uploaded by their users. Some of these laws, as well as follow-on administrative or judicial actions, have also created or may create a new property right in news publications that limits the ability of some online services to interact with or present such content. They may also impose compensation negotiations with news agencies and publishers for the use of such content, which may result in payment obligations that significantly exceed the value that such content provides to Google and its users. •Data localization laws, which generally mandate that certain types of data collected in a particular country be stored and/or processed within that country. •Various U.S. and international laws that govern the distribution of certain materials to children and regulate the ability of online services to collect information from minors. •Various laws with regard to content removal and disclosure obligations, such as the Network Enforcement Act in Germany, which may affect our businesses and operations and may subject us to significant fines if such laws are

interpreted and applied in a manner inconsistent with our practices or when we may not proactively discover such content due to the scale of third-party content and the limitations of existing technologies. Other countries, including Singapore, Australia, and the United Kingdom, have implemented or are considering similar legislation imposing penalties for failure to remove certain types of content. •Various legislative, litigation, and regulatory activity regarding our Google Play billing policies and business model, which could result in monetary penalties, damages and/or prohibition. In addition, the applicability and scope of these laws, as interpreted by the courts, remain uncertain and could harm our business. For example: 17 Table of Contents Alphabet Inc.

•We rely on statutory safe harbors, as set forth in the Digital Millennium Copyright Act and Section 230 of the Communications Decency Act in the United States and the E-Commerce Directive in Europe, against liability for various linking, caching, and hosting activities. Any legislation or court rulings affecting these safe harbors may adversely affect us. There are legislative proposals in both the US and EU that could reduce our safe harbor protection. •Court decisions such as the judgment of the Court of Justice of the European Union (CJEU) on May 13, 2014 on the 'right to be forgotten,' which allows individuals to demand that Google remove search results about them in certain instances, may limit the content we can show to our users and impose significant operational burdens. The introduction of new businesses, products, services, and technologies, our activities in certain jurisdictions, or other actions we take may subject us to additional laws and regulations. Our investment in a variety of new fields, such as healthcare and payment services, may expand the scope of regulations that apply to our business. The costs of compliance with these laws and regulations are high and are likely to increase in the future. Any failure on our part to comply with laws and regulations can result in negative publicity and diversion of management time and effort and may subject us to significant liabilities and other penalties. We are subject to claims, suits, government investigations, and other proceedings that may harm our business, financial condition, and operating results. We are subject to claims, suits, and government investigations involving competition, intellectual property, data privacy and security, consumer protection, tax, labor and employment, commercial disputes, content generated by our users, goods and services offered by advertisers or publishers using our platforms, and other matters. Due to our manufacturing and sale of an expanded suite of products, including hardware as well as Google Cloud offerings, we also are subject to a variety of claims including product warranty, product liability, and consumer protection claims related to product defects, among other litigation. We may also be subject to claims involving health and safety, hazardous materials usage,

other environmental impacts, or service disruptions or failures. Any of these types of legal proceedings can have an adverse effect on us because of legal costs, diversion of management resources, negative publicity and other factors. Determining reserves for our pending litigation is a complex, fact-intensive process that requires significant judgment. The resolution of one or more such proceedings has resulted in, and may in the future result in, additional substantial fines, penalties, injunctions, and other sanctions that could harm our business, financial condition, and operating results. We may be subject to legal liability associated with providing online services or content. Our products and services let users exchange information, advertise products and services, conduct business, and engage in various online activities. We also place advertisements displayed on other companies' websites, and we offer third-party products, services, and/or content. The law relating to the liability of online service providers for others' activities on their services is still somewhat unsettled around the world. Claims have been brought against us for defamation, negligence, breaches of contract, copyright and trademark infringement, unfair competition, unlawful activity, torts, fraud, or other legal theories based on the nature and content of information available on or via our services. We may be subject to claims by virtue of our involvement in hosting, transmitting, marketing, branding, or providing access to content created by third parties. Defense of any such actions could be costly and involve significant time and attention of our management and other resources, may result in monetary liabilities or penalties, and may require us to change our business in an adverse manner. Privacy and data protection regulations are complex and rapidly evolving areas. Adverse interpretations of these laws could harm our business, reputation, financial condition, and operating results. Authorities around the world have adopted and are considering a number of legislative and regulatory proposals concerning data protection and limits on encryption of user data. Adverse legal rulings, legislation, or regulation could result in fines and orders requiring that we change our data practices, which could have an adverse effect on our ability to provide services, harming our business operations. Complying with these evolving laws could result in substantial costs and harm the quality of our products and services, negatively affecting our business, and may be particularly challenging during certain times, such as a natural disaster or pandemic (including COVID-19). Recent legal developments in Europe have created compliance uncertainty regarding transfers of personal data from Europe to the United States. For example, the General Data Protection Regulation (GDPR) applies to all of our activities conducted from an establishment in the EU or related to products and services that we offer to EU 18 Table of Contents Alphabet Inc.

users or customers, or the monitoring of their behavior in the EU. The GDPR creates a range of new compliance obligations. Ensuring compliance with the GDPR is an ongoing commitment that involves substantial costs, and despite our efforts, governmental authorities or others have asserted and may continue to assert that our business practices fail to comply with its requirements. If our operations are found to violate GDPR requirements, we may incur substantial fines, have to change our business practices, and face reputational harm, any of which could have an adverse effect on our business. In particular, serious breaches of the GDPR can result in administrative fines of up to 4% of annual worldwide revenues. Fines of up to 2% of annual worldwide revenues can be levied for other specified violations. The EU-U.S. and the Swiss-U.S. Privacy Shield frameworks allow U.S. companies that self-certify to the U.S. Department of Commerce and publicly commit to comply with specified requirements to import personal data from the EU and Switzerland. Recently, the CJEU ruled that the EU-U.S. Privacy Shield is an invalid transfer mechanism, but upheld Standard Contractual Clauses as a valid transfer mechanism, provided they meet certain requirements. The validity of data transfer mechanisms remains subject to legal, regulatory, and political developments in both Europe and the U.S., such as recent recommendations from the European Data Protection Board, the invalidation of the EU-U.S. Privacy Shield and potential invalidation of other data transfer mechanisms, which could have a significant adverse impact on our ability to process and transfer personal data outside of the EEA. These developments create some uncertainty, and compliance obligations could cause us to incur costs or harm the operations of our products and services in ways that harm our business. We face, and may continue to face intellectual property and other claims that could be costly to defend, result in significant damage awards or other costs (including indemnification awards), and limit our ability to use certain technologies in the future. We, like other internet, technology and media companies, are frequently subject to litigation based on allegations of infringement or other violations of intellectual property rights. In addition, patent-holding companies may frequently seek to generate income from patents they have obtained by bringing claims against us. As we have grown, the number of intellectual property claims against us has increased and may continue to increase as we develop new products, services, and technologies. We have had patent, copyright, trade secret, and trademark infringement lawsuits filed against us claiming that certain of our products, services, and technologies infringe the intellectual property rights of others. Other parties have also sought broad injunctive relief against us by filing claims in U.S. and international courts and the U.S. International Trade Commission (ITC) for exclusion and cease-and-desist orders, which could limit our ability to sell our products

or services in the U.S. or elsewhere if our products or services or those of our customers or suppliers are found to infringe the intellectual property subject to the claims. Adverse results in any of these lawsuits may include awards of monetary damages, costly royalty or licensing agreements (if licenses are available at all), or orders preventing us from offering certain features, functionalities, products, or services. They may also cause us to change our business practices and require development of non-infringing products, services, or technologies, which could result in a loss of revenues for us and otherwise harm our business. Many of our agreements with our customers and partners, including certain suppliers, require us to defend against certain intellectual property infringement claims and in some cases indemnify them for certain intellectual property infringement claims against them, which could result in increased costs for defending such claims or significant damages if there were an adverse ruling in any such claims. Such customers and partners may also discontinue the use of our products, services, and technologies, as a result of injunctions or otherwise, which could result in loss of revenues and adversely affect our business. Moreover, intellectual property indemnities provided to us by our suppliers, when obtainable, may not cover all damages and losses suffered by us and our customers arising from intellectual property infringement claims. Furthermore, in connection with our divestitures, we have agreed, and may in the future agree, to provide indemnification for certain potential liabilities, including those associated with intellectual property claims. Regardless of their merits, intellectual property claims are often time consuming and expensive to litigate or settle. To the extent such claims are successful, they may harm our business, including our product and service offerings, financial condition, or operating results. Risks Related to Ownership of our Stock We cannot guarantee that any share repurchase program will be fully consummated or will enhance long-term stockholder value, and share repurchases could increase the volatility of our stock prices and could diminish our cash reserves. 19 Table of Contents Alphabet Inc.

We engage in share repurchases of our Class C capital stock from time to time in accordance with authorizations from the Board of Directors of Alphabet. Our repurchase program does not have an expiration date and does not obligate Alphabet to repurchase any specific dollar amount or to acquire any specific number of shares. Further, our share repurchases could affect our share trading prices, increase their volatility, reduce our cash reserves and may be suspended or terminated at any time, which may result in a decrease in the trading prices of our stock. The concentration of our stock ownership limits our stockholders' ability to influence corporate matters. Our Class B common stock has 10 votes per share, our Class A common stock has one vote per share, and our Class

C capital stock has no voting rights. As of December 31, 2020, Larry Page and Sergey Brin beneficially owned approximately 85.3% of our outstanding Class B common stock, which represented approximately 51.5% of the voting power of our outstanding common stock. Through their stock ownership, Larry and Sergey have significant influence over all matters requiring stockholder approval, including the election of directors and significant corporate transactions, such as a merger or other sale of our company or our assets, for the foreseeable future. In addition, because our Class C capital stock carries no voting rights (except as required by applicable law), the issuance of the Class C capital stock, including in future stock-based acquisition transactions and to fund employee equity incentive programs, could continue Larry and Sergey's current relative voting power and their ability to elect all of our directors and to determine the outcome of most matters submitted to a vote of our stockholders. This concentrated control limits or severely restricts other stockholders' ability to influence corporate matters and we may take actions that some of our stockholders do not view as beneficial, which could reduce the market price of our Class A common stock and our Class C capital stock. Provisions in our charter documents and under Delaware law could discourage a takeover that stockholders may consider favorable. Provisions in Alphabet's certificate of incorporation and bylaws may have the effect of delaying or preventing a change of control or changes in our management. These provisions include the following: •Our certificate of incorporation provides for a tri-class capital stock structure. As a result of this structure, Larry and Sergey have significant influence over all matters requiring stockholder approval, including the election of directors and significant corporate transactions, such as a merger or other sale of our company or our assets. This concentrated control could discourage others from initiating any potential merger, takeover, or other change of control transaction that other stockholders may view as beneficial. As noted above, the issuance of the Class C capital stock could have the effect of continuing the influence of Larry and Sergey. •Our Board of Directors has the right to elect directors to fill a vacancy created by the expansion of the Board of Directors or the resignation, death, or removal of a director, which prevents stockholders from being able to fill vacancies on our Board of Directors. •Our stockholders may not act by written consent. As a result, a holder, or holders, controlling a majority of our capital stock would not be able to take certain actions without holding a stockholders' meeting. •Our certificate of incorporation prohibits cumulative voting in the election of directors. This limits the ability of minority stockholders to elect director candidates. •Stockholders must provide advance notice to nominate individuals for election to the Board of Directors or to propose matters that can be acted upon at a stockholders' meeting. These provisions may

discourage or deter a potential acquirer from conducting a solicitation of proxies to elect the acquirer's own slate of directors or otherwise attempting to obtain control of our company. •Our Board of Directors may issue, without stockholder approval, shares of undesignated preferred stock. The ability to issue undesignated preferred stock makes it possible for our Board of Directors to issue preferred stock with voting or other rights or preferences that could impede the success of any attempt to acquire us. As a Delaware corporation, we are also subject to certain Delaware anti-takeover provisions. Under Delaware law, a corporation may not engage in a business combination with any holder of 15% or more of its outstanding voting stock unless the holder has held the stock for three years or, among other things, the Board of Directors has approved the transaction. Our Board of Directors could rely on Delaware law to prevent or delay an acquisition of us. 20 Table of Contents Alphabet Inc.

General Risks The continuing impacts of COVID-19 are highly unpredictable and could be significant, and may have an adverse effect on our business, operations and our future financial performance. Since COVID-19 was declared a global pandemic by the World Health Organization, governments and municipalities around the world have instituted measures in an effort to control the spread of COVID-19, including quarantines, shelter-in-place orders, school closings, travel restrictions, and closure of non-essential businesses. The macroeconomic impacts on our business continue to evolve and be unpredictable and may continue to adversely affect our business, operations and financial performance. As a result of the scale of the ongoing pandemic and the speed at which the global community has been impacted, our revenue growth rate and expense as a percentage of our revenues in future periods may differ significantly from our historical rate, and our future operating results may fall below expectations. The future impacts of the ongoing pandemic on our business, operations and future financial performance could include, but are not limited to: •Significant decline in advertising revenues as advertiser spending slows due to an economic downturn. This decline in advertising revenues could persist through and beyond a recessionary period. In addition, we may experience a significant and prolonged shift in user behavior such as a shift in interests to less commercial topics. •Significant decline in other revenues due to a decline or shifts in customer demand. For example, if consumer demand for electronics significantly declines, our hardware revenues could be significantly impacted. •Adverse impacts to our operating income, operating margin, net income, EPS and respective growth rates - particularly if expenses do not decrease across Alphabet at the same pace as revenue declines. Many of our expenses are less variable in nature and/or may not correlate to changes in revenues, including costs associated with our data

centers and facilities as well as employee compensation. As such, we may not be able to decrease them significantly in the short-term, or we may choose not to significantly reduce them in an effort to remain focused on long-term outlook and investment opportunities. •Significant decline in our operating cash flows as a result of decreased advertiser spending and deterioration in the credit quality and liquidity of our customers, which could adversely affect our accounts receivable. Investing cash flows could decrease due to slowing spend on data center and facilities construction projects due to a slowing or stopping of construction or significant restrictions placed on construction. •The prolonged and broad-based shift to a remote working environment continues to create inherent productivity, connectivity, and oversight challenges and could affect our ability to enhance, develop and support existing products and services, detect and prevent spam and problematic content, hold product sales and marketing events, and generate new sales leads, among others. In addition, the changed environment under which we are operating could have an effect on our internal controls over financial reporting as well as our ability to meet a number of our compliance requirements in a timely or quality manner. Additional and/or extended, governmental lockdowns, restrictions or new regulations could significantly impact the ability of our employees and vendors to work productively. Governmental restrictions have been globally inconsistent and it remains unclear when a return to worksite locations or travel will be permitted or what restrictions will be in place in those environments. As we prepare to return our workforce in more locations back to the office in 2021, we may experience increased costs as we prepare our facilities for a safe return to work environment and experiment with hybrid work models, in addition to potential effects on our ability to compete effectively and maintain our corporate culture. Our operating results may fluctuate, which makes our results difficult to predict and could cause our results to fall short of expectations. Our operating results may fluctuate as a result of a number of factors, many outside of our control. As a result, comparing our operating results (including our expenses as a percentage of our revenues) on a period-to-period basis may not be meaningful, and you should not rely on our past results as an indication of our future performance. Our operating results in future quarters may fall below expectations. Any of these events could cause our stock price to fall. Each of the risk factors listed under this Item 1A in addition to the following factors may affect our operating results: •Our ability to attract user and/or customer adoption of, and generate significant revenues from, new products, services, and technologies in which we have invested considerable time and resources. 21 Table of Contents Alphabet Inc.

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Our ability to monetize traffic on Google Search & other properties, YouTube and our Google Network Members' properties across various devices. The amount and timing of operating costs and expenses and capital expenditures related to the maintenance and expansion of our businesses, operations, and infrastructure. Our focus on long-term goals over short-term results. The results of our acquisitions, divestitures, and our investments in risky projects, including new businesses, products, services, and technologies. Our ability to keep our products and services operational at a reasonable cost and without service interruptions. The seasonal fluctuations in internet usage, advertising spending, and underlying business trends such as traditional retail seasonality. Our rapid growth has tended to mask the cyclicality and seasonality of our business. As our growth rate has slowed, the cyclicality and seasonality in our business has become more pronounced and caused our operating results to fluctuate. •Geopolitical events, including trade disputes. •Changes in global business or macroeconomic conditions. Acquisitions, joint ventures, investments, and divestitures could result in operating difficulties, dilution, and other consequences that may harm our business, financial condition, and operating results. Acquisitions, joint ventures, investments and divestitures are important elements of our overall corporate strategy and use of capital, and these transactions could be material to our financial condition and operating results. We expect to continue to evaluate and enter into discussions regarding a wide array of such potential strategic transactions, which could create unforeseen operating difficulties and expenditures. Some of the areas where we face risks include: •Diversion of management time and focus from operating our business to challenges related to acquisitions and other strategic transactions. •Failure to successfully integrate and further develop the acquired business or technology. •Implementation or remediation of controls, procedures, and policies at the acquired company. •Integration of the acquired company's accounting, human resource, and other administrative systems, and coordination of product, engineering, and sales and marketing functions. •Transition of operations, users, and customers onto our existing platforms. •Failure to obtain required approvals on a timely basis, if at all, from governmental authorities, or conditions placed upon approval that could, among other things, delay or prevent us from completing a transaction, or otherwise restrict our ability to realize the expected financial or strategic goals of a transaction. •In the case of foreign acquisitions, the need to integrate operations across different cultures and languages and to address the particular economic, currency, political, and regulatory risks associated with specific countries. •Cultural challenges associated with integrating employees from the acquired company into our organization, and retention of employees from the businesses we acquire. •Liability for activities of the acquired

company before the acquisition, including patent and trademark infringement claims, data privacy and security issues, violations of laws, commercial disputes, tax liabilities, and other known and unknown liabilities. •Litigation or other claims in connection with the acquired company, including claims from terminated employees, customers, former stockholders, or other third parties. Our failure to address these risks or other problems encountered in connection with our past or future acquisitions and other strategic transactions could cause us to fail to realize their anticipated benefits, incur unanticipated liabilities, and harm our business generally. Our acquisitions and other strategic transactions could also result in dilutive issuances of our equity securities, the incurrence of debt, contingent liabilities, or amortization expenses, or impairment of goodwill and/or purchased long-lived assets, and restructuring charges, any of which could harm our financial condition or operating results. 22 Table of Contents Alphabet Inc.

Also, the anticipated benefits or value of our acquisitions and other strategic transactions may not materialize. In connection with our divestitures, we have agreed, and may in the future agree, to provide indemnification for certain potential liabilities, which may harm our financial condition or operating results. If we were to lose the services of key personnel, we may not be able to execute our business strategy. Our future success depends in large part upon the continued service of key members of our senior management team. For instance, Sundar Pichai is critical to the overall management of Alphabet and its subsidiaries and plays an important role in the development of our technology, maintaining our culture and setting our strategic direction. All of our executive officers and key employees are at-will employees, and we do not maintain any key-person life insurance policies. The loss of key personnel could seriously harm our business. We rely on highly skilled personnel and, if we are unable to retain or motivate key personnel, hire qualified personnel, or maintain our corporate culture, we may not be able to grow effectively. Our performance largely depends on the talents and efforts of highly skilled individuals. Our ability to compete effectively and our future success depends on our continuing to identify, hire, develop, motivate, and retain highly skilled personnel for all areas of our organization. Competition in our industry for qualified employees is intense, and certain of our competitors have directly targeted our employees. In addition, our compensation arrangements, such as our equity award programs, may not always be successful in attracting new employees and retaining and motivating our existing employees. Restrictive immigration policy and regulatory changes may also impact our ability to hire, mobilize or retain some of our global talent. In addition, we believe that our corporate culture fosters innovation,

creativity, and teamwork. As our organization grows and evolves, we may need to implement more complex organizational management structures or adapt our corporate culture and work environments to ever-changing circumstances, such as during times of a natural disaster or pandemic (including COVID-19), and these changes could impact our ability to compete effectively or have an adverse impact on our corporate culture. We are exposed to fluctuations in the market values of our investments and, in some instances, our financial statements incorporate valuation methodologies that are subjective in nature resulting in fluctuations over time. The market value of our investments can be negatively affected by liquidity, credit deterioration or losses, performance and financial results of the underlying entities, foreign exchange rates, changes in interest rates, including changes that may result from the implementation of new benchmark rates, the effect of new or changing regulations, the stock market in general, or other factors. The effect of COVID-19 on our impairment assessment for non-marketable investments requires significant judgment due to the uncertainty around the duration and severity of the impact. We measure certain of our non-marketable equity and debt investments, certain other instruments including stock-based compensation awards settled in the stock of certain Other Bets, and certain assets and liabilities acquired in a business combination, at fair value on a nonrecurring basis. The determination of fair value involves use of appropriate valuation methods and certain unobservable inputs, require management judgment and estimation, and may change over time. We adjust the carrying value of our non-marketable equity investments to fair value for observable transactions of identical or similar investments of the same issuer or for impairments. All gains and losses on non-marketable equity securities, realized and unrealized, are recognized in other income (expense), which increases the volatility of our other income (expense). The unrealized gains and losses we record on our non-marketable equity securities in any particular period may differ significantly from the realized gains or losses we ultimately experience on such investments. As a result of these factors, the value or liquidity of our cash equivalents, as well as our marketable and non-marketable securities could decline and result in a material impairment, which could adversely affect our financial condition and operating results. We could be subject to changes in tax rates, the adoption of new U.S. or international tax legislation, or exposure to additional tax liabilities. Our future income taxes could be negatively affected by earnings being lower than anticipated in jurisdictions that have lower statutory tax rates and higher than anticipated in jurisdictions that have higher statutory tax rates, the net gains and losses recognized by legal entities on certain hedges and related hedged intercompany and other transactions

under our foreign exchange risk management program, changes in the valuation of our deferred tax 23 Table of Contents Alphabet Inc.

assets or liabilities, the application of different provisions of tax laws or changes in tax laws, regulations, or accounting principles (including changes in the interpretation of existing laws), as well as certain discrete items. In addition, we are subject to regular review and audit by both domestic and foreign tax authorities. As a result, we have received, and may in the future receive, assessments in multiple jurisdictions, including in Europe, on various tax-related assertions, such as transfer-pricing adjustments or permanent-establishment claims. Any adverse outcome of such a review or audit could have a negative effect on our operating results and financial condition and could require us to change our business practices in a manner adverse to our business. It may also subject us to additional litigation and regulatory inquiries, resulting in the diversion of management's time and attention. In addition, the determination of our worldwide provision for income taxes and other tax liabilities requires significant judgment, and there are many transactions and calculations for which the ultimate tax determination is uncertain. Although we believe our estimates are reasonable, the ultimate tax outcome may differ from the amounts recorded in our financial statements and may affect our financial results in the period or periods for which such determination is made. Furthermore, due to shifting economic and political conditions, tax policies, laws, or rates in various jurisdictions may be subject to significant changes in ways that impair our financial results. Various jurisdictions around the world have enacted or are considering digital services taxes, which could lead to inconsistent and potentially overlapping international tax regimes. The Organization for Economic Cooperation and Development (OECD) recently released proposals relating to its initiative for modernizing international tax rules, with the goal of having different countries implement a modernized and aligned international tax framework, but there can be no guarantee that this will occur. In addition, in response to significant market volatility and disruptions to business operations resulting from the global spread of COVID-19, legislatures and taxing authorities in many jurisdictions in which we operate may propose changes to their tax rules. These changes could include modifications that have temporary effect, and more permanent changes. The impact of these potential new rules on us, our long-term tax planning, and our effective tax rate could be material. The trading price for our Class A common stock and non-voting Class C capital stock may continue to be volatile. The trading price of our stock has at times experienced substantial price volatility and may continue to be volatile. In addition to the factors discussed in this report, the trading price of our Class A common stock and Class C capital stock may fluctuate widely in response to

various factors, many of which are beyond our control, including, among others announcements by us or our competitors of acquisitions, divestitures, investments, new products, significant contracts, commercial relationships, or capital commitments; recommendations by securities analysts or changes in their earnings estimates; announcements about our or our competitors' earnings that are not in line with analyst expectations, the risk of which is enhanced, in our case, because it is our policy not to give guidance on earnings; commentary by industry and market professionals about our products, strategies, and other matters affecting our business and results, regardless of its accuracy; the volume of shares of Class A common stock and Class C capital stock available for public sale; sales of Class A common stock and Class C capital stock by us or by our stockholders (including sales by our directors, executive officers, and other employees); short sales, hedging, and other derivative transactions on shares of our Class A common stock and Class C capital stock; the size, timing and share class of any share repurchase program; and the perceived values of Class A common stock and Class C capital stock relative to one another. In addition, the stock market in general, which can be affected by various factors, including overall economic and political conditions, and the market for technology companies in particular, have experienced extreme price and volume fluctuations that have often been unrelated or disproportionate to the operating performance of those companies. These broad market and industry factors may harm the market price of our Class A common stock and our Class C capital stock, regardless of our actual operating performance.

D4.1 Management's discussion and analysis of financial condition and results of operations - alphabet 2021 10-K filing

ITEM 7.MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS Please read the following discussion and analysis of our financial condition and results of operations together with our consolidated financial statements and related notes included under Part II, Item 8 of this Annual Report on Form 10-K. We have omitted discussion of 2018 results where it would be redundant to the discussion previously included in Part II, Item 7 of our 2019 Annual Report on Form 10-K. Trends in Our Business The following long-term trends have contributed to the results of our consolidated operations, and we anticipate that they will continue to affect our future results: •Users' behaviors and advertising continue to shift online as the digital economy evolves. The continuing shift from an offline to online world has contributed to the growth of our business since inception, contributing to revenue growth, and we expect that this online shift will continue to benefit our business. •Users are increasingly using

diverse devices and modalities to access our products and services, and our advertising revenues are increasingly coming from new formats. Our users are accessing the Internet via diverse devices and modalities, such as smartphones, wearables and smart home devices, and want to feel connected no matter where they are or what they are doing. We seek to expand our products and services to stay in front of these trends in order to maintain and grow our business. We generate our advertising revenues increasingly from different channels, including mobile, and newer advertising formats, and the margins from the advertising revenues from these channels and newer products have generally been lower than those from traditional desktop search. Additionally, as the market for a particular device type or modality matures, our revenues may be affected. For example, growth in the global smartphone market has slowed due to various factors, including increased market saturation in developed countries, which can affect our mobile advertising revenue growth rates. We expect TAC paid to our distribution partners and Google Network Members to increase as our revenues grow and to be affected by changes in device mix; geographic mix; partner mix; partner agreement terms; the percentage of queries channeled through paid access points; product mix; the relative revenue growth rates of advertising revenues from different channels; and revenue share terms. We expect these trends to continue to affect our revenue growth rates and put pressure on our overall margins. •As online advertising evolves, we continue to expand our product offerings which may affect our monetization. As interactions between users and advertisers change and as online user behavior evolves, we continue to expand and evolve our product offerings to serve their changing needs. Over time, we expect our monetization trends to fluctuate. For example, we have seen an increase in YouTube ads and Google Play ads, which monetize at a lower rate than our traditional search ads. •As users in developing economies increasingly come online, our revenues from international markets continue to increase and movements in foreign exchange rates affect such revenues. The shift to online, as well as the advent of the multi-device world, has brought opportunities outside of the U.S., including in emerging markets, such as India, where we continue to invest heavily and develop localized versions of our products and relevant advertising programs useful to our users in these markets. This has led to a trend of increased revenues from international markets over time, as regions with emerging markets, such as APAC, have demonstrated higher revenue growth rates. We expect that our results will continue to be affected by our performance in these markets, particularly as low-cost mobile devices become more available. This trend could impact our margins as developing markets initially monetize at a lower rate than more mature markets. Our international revenues represent a significant portion of our revenues and are subject to

fluctuations in foreign currency exchange rates relative to the U.S. dollar. While we have a foreign exchange risk management program designed to reduce our exposure to these fluctuations, this program does not fully offset their effect on our revenues and earnings. 30 Table of Contents Alphabet Inc.

•The portion of our revenues that we derive from non-advertising revenues is increasing and may affect margins. Non-advertising revenues have grown over time. We expect this trend to continue as we focus on expanding our offerings to our users through products and services like Google Cloud, Google Play, hardware products, and YouTube subscriptions. Across these initiatives, we currently derive non-advertising revenues primarily from sales of apps, in-app purchases, digital content products, and hardware; and licensing and service fees, including fees received for Google Cloud services and subscription and other services. The margins on these revenues vary significantly and may be lower than the margins on our advertising revenues. A number of our Other Bets initiatives are in their initial development stages, and as such, the sources of revenues from these businesses could change over time and the revenues could be volatile. As we continue to serve our users and expand our businesses, we will invest heavily in operating and capital expenditures. We continue to make significant R&D investments in areas of strategic focus such as advertising, cloud, machine learning, and search, as well as in new products and services. In addition, we expect to continue to invest in land and buildings for data centers and offices, and information technology assets, which includes servers and network equipment, to support the long-term growth of our business. In addition, acquisitions and strategic investments are an important part of our strategy and use of capital, contributing to the breadth and depth of our offerings, expanding our expertise in engineering and other functional areas, and building strong partnerships around strategic initiatives. For example, in 2020 we announced our Google for India Digitization Fund to invest approximately $10 billion into India over the next 5-7 years through a mix of equity investments, partnerships, and operational, infrastructure and ecosystem investments. •We face continuing changes in regulatory conditions, laws and public policies, which could impact our business practices and financial results. Changes in social, political, economic, tax, and regulatory conditions or in laws and policies governing a wide range of topics and related legal matters have resulted in fines and caused us to change our business practices. As these global trends continue, for example the recent antitrust complaints filed by the U.S. Department of Justice and a number of state Attorneys General as well as the News Media Bargaining Code drafted by the Australian Competition and Consumer Commission, our cost of doing business may increase and our ability to pursue certain business models or offer

certain products or services may be limited. •Our employees are critical to our success and we expect to continue investing in them. Our employees are among our best assets and are critical for our continued success. We expect to continue hiring talented employees around the globe and to provide competitive compensation programs to our employees. The Impact of COVID-19 on our Results and Operations In late 2019, an outbreak of COVID-19 emerged and by March 11, 2020 was declared a global pandemic by the World Health Organization. Across the United States and the world, governments and municipalities instituted measures in an effort to control the spread of COVID-19, including quarantines, shelter-in-place orders, school closings, travel restrictions and the closure of non-essential businesses. The macroeconomic impacts of COVID-19 are significant and continue to evolve, as exhibited by, among other things, a rise in unemployment, changes in consumer behavior, and market volatility. We began to observe the impact of COVID-19 and the related reductions in global economic activity on our financial results in March 2020 when, despite an increase in users' search activity, our advertising revenues declined compared to the prior year due to a shift of user search activity to less commercial topics and reduced spending by our advertisers. During the course of the quarter ended June 30, 2020, we observed a gradual return in user search activity to more commercial topics, followed by increased spending by our advertisers that continued throughout the second half of 2020. We continue to assess the realized and potential credit deterioration of our customers due to changes in the macroeconomic environment, which has been reflected in our allowance for credit losses for accounts receivable. Additionally, over the course of the year we experienced variability in our margins as many of our expenses are less variable in nature and/or may not correlate to changes in revenues, including costs associated with our data centers and facilities as well as employee compensation. Also, market volatility has contributed to fluctuations in the valuation of our equity investments. 31 Table of Contents Alphabet Inc.

While we continued to make investments in land and buildings for data centers, offices and information technology, in 2020 we slowed the pace of our investments, primarily as it relates to office facilities, as a result of COVID-19. The ongoing impact of COVID-19 on our business continues to evolve and be unpredictable. For example, to the extent the pandemic disrupts economic activity globally we, like other businesses, are not immune to continued adverse impacts to our business, operations and financial results from volatility in advertising spending, changes in user behavior and preferences, credit deterioration and liquidity of our customers, depressed economic activity, or volatility in capital markets.

The ongoing impact will depend on a number of factors, including the duration and severity of the pandemic; the uneven impact to certain industries; advances in testing, treatment and prevention including vaccines; and the macroeconomic impact of government measures to contain the spread of the virus and related government stimulus measures. To address the potential impact to our business, over the near-term, we continue to evaluate the pace of our investment plans, including, but not limited to, our hiring, investments in data centers, servers, network equipment, real estate and facilities, marketing and travel spending, as well as taking certain measures to support our customers, our overall workforce, and communities we operate in. As we look to return our workforce in more locations back to the office in 2021, we may experience increased costs as we prepare our facilities for a safe return to work environment and experiment with hybrid work models. At the same time, we believe the current environment is accelerating digital transformation and we remain focused on innovating and investing in the services we offer to consumers and businesses. For example, as it relates to Google Cloud, we continue to invest aggressively around the globe in our go-to-market capabilities, product development and technical infrastructure to support long term growth. The ongoing impact of COVID-19 and the extent of these measures we have taken and the additional measures that we may implement could have a material impact on our financial results. Our past results may not be indicative of our future performance, and historical trends in our financial results may differ materially.

D4.2 Quantitative and qualitative disclosures about market risk - alphabet 2021 10-K filing

ITEM 7A.QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK We are exposed to financial market risks, including changes in foreign currency exchange rates, interest rates, and equity investment risks. Foreign Currency Exchange Risk We transact business globally in multiple currencies. Our international revenues, as well as costs and expenses denominated in foreign currencies, expose us to the risk of fluctuations in foreign currency exchange rates against the U.S. dollar. Principal currencies hedged included the Australian dollar, British pound, Canadian dollar, Euro and Japanese yen. For the purpose of analyzing foreign currency exchange risk, we considered the historical trends in foreign currency exchange rates and determined that it was reasonably possible that adverse changes in exchange rates of 10% could be experienced in the near term. We use foreign exchange forward contracts to offset the foreign exchange risk on our assets and liabilities denominated in currencies other than the functional currency of the subsidiary.

These forward contracts reduce, but do not entirely eliminate, the effect of foreign currency exchange rate movements on our assets and liabilities. The foreign currency gains and losses on the assets and liabilities are recorded in other income (expense), net, which are offset by the gains and losses on the forward contracts. If an adverse 10% foreign currency exchange rate change was applied to total monetary assets, liabilities, and commitments denominated in currencies other than the functional currencies at the balance sheet date, it would have resulted in an adverse effect on income before income taxes of approximately $8 million and $497 million as of 47 Table of Contents Alphabet Inc.

December 31, 2019 and 2020, respectively, after consideration of the effect of foreign exchange contracts in place for the years ended December 31, 2019 and 2020. We use foreign currency forwards and option contracts, including collars (an option strategy comprised of a combination of purchased and written options) to protect our forecasted U.S. dollar-equivalent earnings from changes in foreign currency exchange rates. When the U.S. dollar strengthens, gains from foreign currency options and forwards reduce the foreign currency losses related to our earnings. When the U.S. dollar weakens, losses from foreign currency collars and forwards offset the foreign currency gains related to our earnings. These hedging contracts reduce, but do not entirely eliminate, the effect of foreign currency exchange rate movements. We designate these contracts as cash flow hedges for accounting purposes. We reflect the gains or losses of foreign currency spot rate changes as a component of AOCI and subsequently reclassify them into revenues to offset the hedged exposures as they occur. If the U.S. dollar weakened by 10% as of December 31, 2019 and 2020, the amount recorded in AOCI related to our foreign exchange contracts before tax effect would have been approximately $1.1 billion and $912 million lower as of December 31, 2019 and 2020, respectively. The change in the value recorded in AOCI would be expected to offset a corresponding foreign currency change in forecasted hedged revenues when recognized. We use foreign exchange forward contracts designated as net investment hedges to hedge the foreign currency risks related to our investment in foreign subsidiaries. These forward contracts serve to offset the foreign currency translation risk from our foreign operations. If the U.S. dollar weakened by 10%, the amount recorded in cumulative translation adjustment ("CTA") within AOCI related to our net investment hedge would have been approximately $936 million and $1 billion lower as of December 31, 2019 and 2020, respectively. The change in value recorded in CTA would be expected to offset a corresponding foreign currency translation gain or loss from our investment in foreign subsidiaries. Interest Rate Risk Our Corporate Treasury investment strategy is to achieve a return that will allow us to preserve capital and maintain liquidity. We invest

primarily in debt securities including those of the U.S. government and its agencies, corporate debt securities, mortgage-backed securities, money market and other funds, municipal securities, time deposits, asset backed securities, and debt instruments issued by foreign governments. By policy, we limit the amount of credit exposure to any one issuer. Our investments in both fixed rate and floating rate interest earning securities carry a degree of interest rate risk. Fixed rate securities may have their fair market value adversely affected due to a rise in interest rates, while floating rate securities may produce less income than predicted if interest rates fall. Unrealized gains or losses on our marketable debt securities are primarily due to interest rate fluctuations as compared to interest rates at the time of purchase. For certain fixed and variable rate debt securities, we have elected the fair value option for which changes in fair value are recorded in other income (expense), net. We measure securities for which we have not elected the fair value option at fair value with gains and losses recorded in AOCI until the securities are sold, less any expected credit losses. We use value-at-risk ("VaR") analysis to determine the potential effect of fluctuations in interest rates on the value of our marketable debt security portfolio. The VaR is the expected loss in fair value, for a given confidence interval, for our investment portfolio due to adverse movements in interest rates. We use a variance/covariance VaR model with 95% confidence interval. The estimated one-day loss in fair value of our marketable debt securities as of December 31, 2019 and 2020 are shown below (in millions): As of December 31, 12-Month Average As of December 31, 2019 2020 2019 2020 Risk Category - Interest Rate $ 104 $ 144 $ 90 $ 145

Actual future gains and losses associated with our marketable debt security portfolio may differ materially from the sensitivity analyses performed as of December 31, 2019 and 2020 due to the inherent limitations associated with predicting the timing and amount of changes in interest rates and our actual exposures and positions. VaR analysis is not intended to represent actual losses but is used as a risk estimation. Equity Investment Risk Our marketable and non-marketable equity securities are subject to a wide variety of market-related risks that could substantially reduce or increase the fair value of our holdings. Our marketable equity securities are publicly traded stocks or funds and our non-marketable equity securities are investments in privately held companies, some of which are in the startup or development stages. 48 Table of Contents Alphabet Inc.

We record our marketable equity securities not accounted for under the equity method at fair value based on readily determinable market values, of which publicly traded stocks and mutual funds are subject to market price volatility, and represent $3.3 billion and $5.9 billion of our investments as of December 31, 2019 and 2020, respectively. A hypothetical

adverse price change of 30% on our December 31, 2020 balance, which could be experienced in the near term, would decrease the fair value of our marketable equity securities by $1.8 billion. From time to time, we may enter into derivatives to hedge the market price risk on certain of our marketable equity securities. Our non-marketable equity securities not accounted for under the equity method are adjusted to fair value for observable transactions for identical or similar investments of the same issuer or impairment (referred to as the measurement alternative). The fair value measured at the time of the observable transaction is not necessarily an indication of the current fair value as of the balance sheet date. These investments, especially those that are in the early stages, are inherently risky because the technologies or products these companies have under development are typically in the early phases and may never materialize and they may experience a decline in financial condition, which could result in a loss of a substantial part of our investment in these companies. The success of our investment in any private company is also typically dependent on the likelihood of our ability to realize appreciation in the value of our investments through liquidity events such as public offerings, acquisitions, private sales or other market events. As of December 31, 2019 and 2020, the carrying value of our non-marketable equity securities, which were accounted for under the measurement alternative, was $11.4 billion and $18.9 billion, respectively. Valuations of our equity investments in private companies are inherently more complex due to the lack of readily available market data. Volatility in the global economic climate and financial markets could result in a significant impairment charge relating to our non-marketable equity securities. Changes in valuation of non-marketable equity securities may not directly correlate with changes in valuation of marketable equity securities. Additionally, observable transactions at lower valuations could result in significant losses on our non-marketable equity securities. The effect of COVID-19 on our impairment assessment requires significant judgment due to the uncertainty around the duration and severity of the impact. The carrying values of our equity method investments, which totaled approximately $1.3 billion and $1.4 billion as of December 31, 2019 and 2020, respectively, generally do not fluctuate based on market price changes, however these investments could be impaired if the carrying value exceeds the fair value and is not expected to recover. For further information about our equity investments, please refer to Note 1 and Note 3 of the Notes to Consolidated Financial Statements included in Part II of this Annual Report on Form 10-K.

E5 Overlap of the risk factors of 2020 and 2021 10-K filing of Alphabet

Figure 1: Overlap between the Alphabet risk section 2020 and 2021