ETH *zürich*　　　　　　　　D MTEC

Analysis of ByteDance

with a close look on Douyin / TikTok

Author:　　　Xiaoye SHI

Supervisor:　　Prof. Dr. Didier SORNETTE

A thesis submitted to the

Department of Management, Technology and Economics (D-MTEC)

of the

Swiss Federal Institute of Technology Zurich (ETHZ)

in partial fulfilment of the requirements for the degree of

Master of Science in Management, Technology and Economics

June 2019

Acknowledgements

I would like to thank my supervisor Prof. Dr. Didier Sornette, who has kindly given me countless guidance and advice throughout the Master thesis. I appreciate the opportunity to work on this interesting topic under the Chair of Entrepreneurial Risks and is deeply grateful for all the help received along the process.

I also want to express my deepest gratitude to my parents, who have been supportive and encouraging under all circumstances. Without them, I would not be able to become the person I am today.

Abstract

In 2018, ByteDance, a young Internet company with only 6 years of history, broke out on various news headlines as the highest valued unicorn. With the acquisitions of musical.ly and Flipgram, the company's flagship product Douyin strikes to develop its global presence under the name TikTok. This thesis analyzed Douyin's historical growth and revenue model. As a main revenue driver, future user growth is predicted and calibrated by extending the methodology proposed in earlier studies by Cauwels and Sornette. We considered three growth scenarios – base, high and extreme, and estimated Douyin as well as ByteDance's value based on comparable company analysis. ByteDance's key performance metrics and multiples were compared with four other firms in the similar industry, Facebook, Weibo, Momo and iQIYI. The study found out that in order to support the company's current valuation, Douyin needs to keep its user growth at a pace similar to the extreme growth scenario. However, it appears that with its current MAU reaching the maximum carrying capacity suggested in the high growth scenario, its future user growth rate is likely to slow down or even stop in the following years. With other products of the company growing at their current pace, ByteDance's current valuation of 75 billion USD is considered to be too high.

Keywords: mobile internet, short video industry, in-feed ads, logistic function, comparable company analysis

Table of Contents

Acronyms and Vocabulary

In alphabetical order:

ARPU	average revenue per user, calculated as the revenue divided by the number of users (often yearly revenue divided by average MAU of the year)
CCA	comparable company analysis
CPC	cost per click
CPM	cost per mille, also known as cost per thousand views
CPT	cost per time
DAU	daily active user – the number of unique, engaged users per day
DAU/MAU	the proportion of monthly users who use the product on a daily basis – reflects user stickiness
DCF	discounted cash flow
EBITDA	earnings before interest, tax, depreciation, and amortization
EV	enterprise value, as the total market value of the company net of cash
FMV	fair market value
MAU	monthly active user – the number of unique, engaged users per month
M&A	mergers and acquisitions
MC	market capitalization
p.a.	per annum
P/E	price-to-earnings ratio, calculated as the market price (per share) divided by earnings (per share) from the most recent financial year
P/S	price-to-sales ratio, also known as sales multiple, calculated as the market price (per share) divided by sales (per share) from the most recent financial year
UGC	user generated content

1 Introduction

1.1 Context

1.1.1 Internet

Internet, the contraction of interconnected network, is a network of networks of all sorts of types and scopes connected by various technologies. It carries a wide range of resources and services. Originated in the twentieth century, Internet kept gaining popularity globally.

As shown in Figure 1, the global number of Internet users has been growing since 2005. By the end of 2018, 3.9 billion people had access to Internet, 52 inhabitants out of a hundred were using Internet services. If we break down countries around the world into three categories based on the level of development they are currently at, we can see that the positive trend of user growth does not only occur in one category. Countries of all three categories have experienced upward growth curve – the increasing demand and usage of internet is universal and phenomenal.

The rapid adoption of Internet, the fast development and convergence of digital technologies further stimulated the innovation and widened its reach. Mobile phone became more prevalent. Instead of accessing Internet through fixed-line devices like computers, people could browse web anywhere, with some pocket-sized, multi-purpose devices that function fully as computers – we call them smartphones.

The ubiquity of mobile internet and smartphones opened up a large new market. Internet now serves as a medium of a broad spectrum of areas including content services, communications, and commerce (Kim, Chan, & Gupta, 2007; McKnight & Bailey, 1995). In November 2018, 48% of the global web traffic come from mobile internet, with Asia in the leading position (StatCounter., n.d.). We can see from Figure 2 that, by January 2019, Internet already has almost four and a half billion active users, out of which nearly 90% are also active mobile internet users, 74% of which are active on mobile

social media (We Are Social, & DataReportal, n.d.). No doubt, the mobile social media sector is becoming one of the most promising and lucrative market.
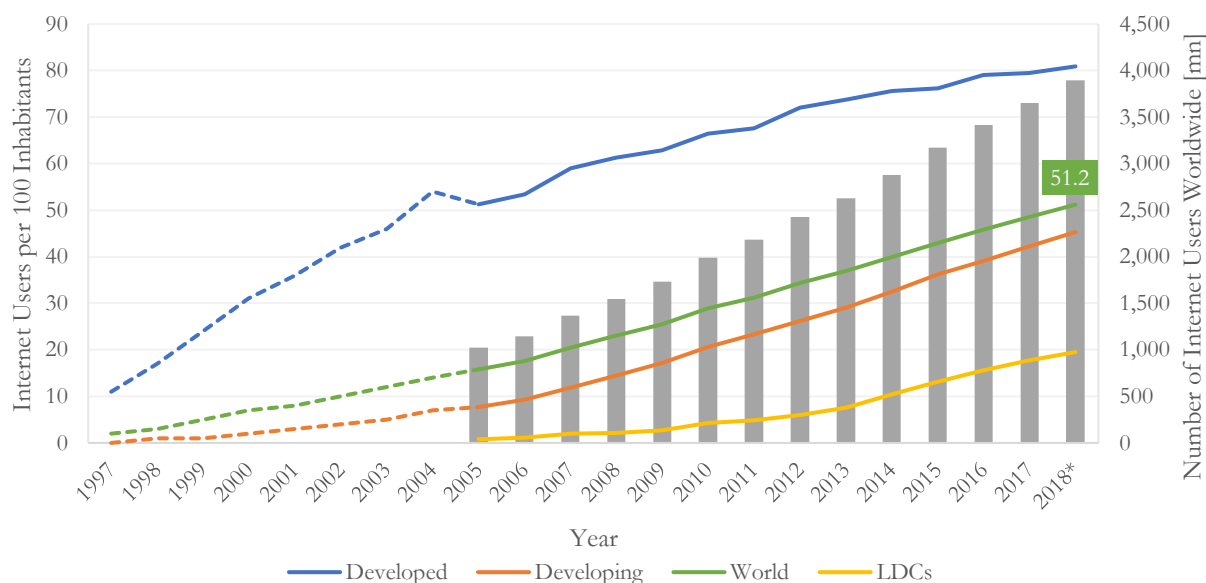

Figure 1: Internet users per 100 inhabitants from 1997 to 2018 (primary axis)[1]; number of Internet users worldwide from 2005 to 2018, in millions (secondary axis)[2]

Note: rounded values; * represents estimates

---

[1] The number of Internet users is grouped into three categories: world, developed countries, developing countries, and LDCs (least developed countries, data is available only from 2005). Classifications of countries into developed/developing/LDCs are based on the UN M49 (http://www.itu.int/en/ITU-D/Statistics/Pages/definitions/regions.aspx). Lines were plotted in two different styles, with 1997-2005 being dotted and 2005-2018 being solid, as the two sets of time-series data were retrieved from different sources. Source: ITU World Telecommunication (solid line) / ICT Indicators database (dotted line)

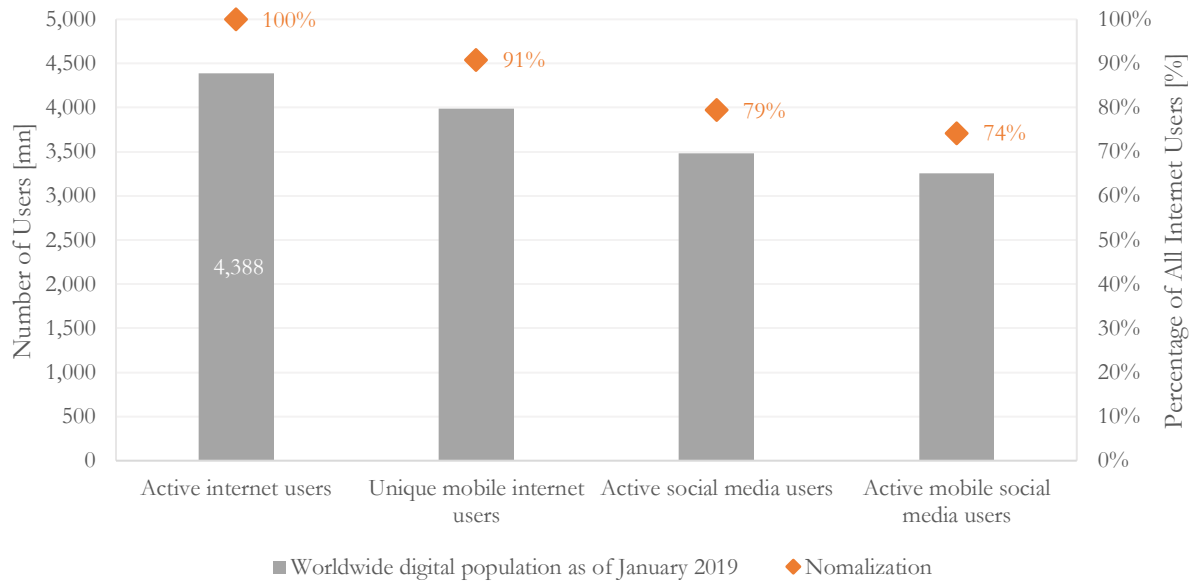[2] Source: ITU World Telecommunication / ICT Indicators database

Figure 2: Global digital population as of January 2019, in millions (primary axis) and in percentage (secondary axis)[3]

With nearly 772 million internet users by end of 2017, 21% of the world total number, China is undoubtfully the biggest market for Internet services. Leveraging the tremendous market size, more and more Internet companies were set up. ByteDance was one of them.

1.1.2 ByteDance

Founded by Yiming Zhang in March 2012, Beijing ByteDance Technology Co Ltd. (later referred to as "ByteDance") is now considered the most valuable unicorn[4] in the world. With the closure of a funding from SoftBank Group Corp., KKR&Co., and General Atlantic, the company is now valued at $75 billion, surpassing of Uber Technologies Inc., valued at $72 billion[5] (Ramli, Wang, & Chen, 2018).

---

[3] The number of users worldwide were normalized to percentage with the number of active internet users (totaled 4,388 million) being 100%. Source: Statista

[4] The concept of unicorn was coined by Aileen Lee in 2013, referring to a privately held company valued over 1 billion US Dollars.

[5] Source: CB Insights by October 2018

ByteDance has a global presence – its products and services are available in over 150 countries in the world, in more than 75 languages. As a breakthrough point of the company, ByteDance established its own artificial intelligence (AI) lab that focuses on utilizing machine learning and deep learning into its products and services (ByteDance, 2018).

Taking a closer look at ByteDance, the company has four products, all operating under AI technology. Counting all its products and services, ByteDance has a total monthly active users (MAU) of 598 million by December 2018, accounting for 52.9% of the total MAU of mobile Internet. The number excludes overlapping users of multiple platforms (QuestMobile, 2019). Out of all products, Toutiao (TopBuzz) and Douyin (TikTok) are the two flagship products and contribute to a substantial proportion of the company's revenue (Byford, 2018).

A brief overview on each product was given below.

Douyin (TikTok)

Douyin, known as TikTok internationally, is an online short-video mobile application that allows users to create, post, and share self-created videos (Lam & Li, 2018). Launched by ByteDance in September 2016, it is now one of the leading social network apps by number of downloads as well as active users (ByteDance, 2018).

In February and November 2017, ByteDance acquired short video apps Flipgram and musical.ly, respectively and has been expanding its international presence ever since. Up until the end of 2018, Douyin is available in over 150 countries and regions, and has been on the top of the lists of the most downloaded mobile app in many countries, including Japan, Thailand, and China. As shown in Figure 3, with a MAU of 500 million, Douyin (TikTok) has the 9th highest number of monthly active users worldwide by January 2019, among all other popular social network apps, combing iOS and Android downloads.
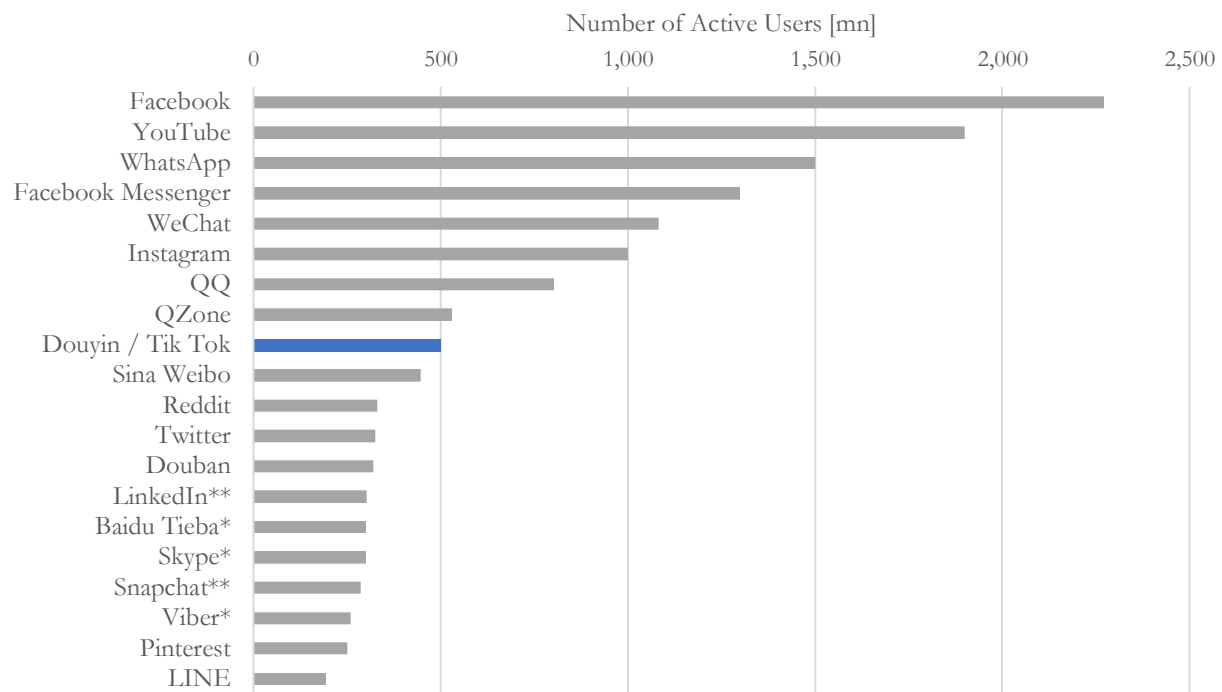
Number of Active Users [mn]

Facebook	
YouTube	
WhatsApp	
Facebook Messenger	
WeChat	
Instagram	
QQ	
QZone	
Douyin / Tik Tok	
Sina Weibo	
Reddit	
Twitter	
Douban	
LinkedIn**	
Baidu Tieba*	
Skype*	
Snapchat**	
Viber*	
Pinterest	
LINE	

Figure 3: Most popular social networks worldwide as of January 2019, ranked by number of active users (in millions)[6]

Douyin is designed for young audience with a focus on Generation Z (Yang, 2018). With a customized background music, users can create a 15-second video with unique effects and share it with friends or the broader audience out in the world (ByteDance, 2018). It is also very popular to do lip sync along different music with the app.

By December 2018, Douyin has a MAU of 426 million in China (QuestMobile, 2019).

Toutiao (TopBuzz)

Toutiao, with a meaning of "headline" in Chinese, is the first product of ByteDance. It is an online platform that aggregates news and content, and recommends and delivers them based on user's interests (ByteDance, 2018). With the employment of AI technology, Toutiao could analyze user's reaction and interaction of past content. The technology will study if users taped the news title into

---

[6] Source: Statista

the detailed page, if they liked it, or even the length of time they spend on reading each post. The app would thereby generate individualized feeds of contents through the machine learning algorithm and deliver them to the corresponding end users (Hariharan, 2017; Jing, 2018). Every time users open or refresh the app, new feeds would be automatically pushed, loaded, and displayed without them actively searching for contents. These contents recommended to the users in the end are thought to be of their interests, habits, and preferences (Smolentceva, 2019).

By December 2018, Toutiao has a MAU of 240 million in China (QuestMobile, 2019).

Topbuzz is the international version of Toutiao that is available for users overseas. Except utilizing the company's AI technology, like all the other products, ByteDance also aims at partnering with local media to collect and generate the content (Knight, 2018).

Huoshan (Vigo Video)

Huoshan, known as Vigo Video internationally, is a short-video app that is similar to Douyin on many aspects. It empowers users to create and edit videos with a wide range of tools, stickers and effects (ByteDance, 2018). Similar to Douyin, all videos posted and shared on Huoshan are restricted to a time limit of 15 seconds. However, Huoshan focuses more on user-generated contents, with most content being related to funny acts, live broadcasting of people eating, and square dancing (Borak, 2019).

By December 2018, Huoshan has a MAU of 99 million in China (QuestMobile, 2019).

Xigua Video (Buzz Video)

Xigua Video, known as Buzz Video outside China, is an online platform that aims for content sharing in the form of videos with no time limits (Tang, 2019). Though most videos are over four to five minutes in length (Borak, 2019). Users would get a completely new lists of videos for every refresh they do in the app. Different from Douyin and Huoshan, users have to apply and become a registered user, content creator and provider of Toutiao to be eligible for sharing contents on Xigua. There are

more than 1.5 million registered content creators on the platform by the end of 2018 (QuestMobile, 2019).

By December 2018, Xigua has a MAU of 121 million in China (QuestMobile, 2019).

The company has been growing at a rapid speed. In 2017, the company reached its 15 billion CNY (2.1 billion US dollars) target with a slim profit (Dredge, 2019). In 2018, the company made a total revenue of 50 billion CNY (7.1 billion US dollars) – this was at the lower end of the company's annual target, which is 50 to 55 billion CNY (L. Y. Chen & Wang, 2019). Note that the company made a 1.2 billion US dollars net loss on TikTok's overseas expansion the same year, giving a profit margin of -16.9% (Zhang & Osawa, 2019). [7]

For 2019, ByteDance has set its revenue target to 100 billion CNY (14.3 billion US dollars), double the amount realized in 2018 (Xu, 2019).

1.2 Motivation

The rapidly evolving industry accelerates all forms of related capital operations, for example, mergers and acquisitions (M&As) are carried out more frequently (Calipha, Tarba, & Brock, 2010; Holterman & van de Pol, 2016). Under the fast growing economy, it is ultimately important to choose an adequate valuation method in order to reach a fair valuation of the company. Approaches that are based on market, cost, and earnings are widely used. However, as most Internet technology firms are still at their early stage of development, their business model and characteristics of are fundamentally different from those of traditional industries. For instance, most have relatively high costs and unstable profitability, making the traditional valuation based on earnings less appropriate.

---

[7] In this thesis, the foreign exchange rate for USD/CNY is assumed to be fixed at 7(1 USD = 7 CNY, 1 CNY = 0.14 USD), long-term, unless otherwise stated.

This thesis aims to discuss the applications as well as limits of traditional valuation methods. Variations and modifications of the model will be proposed based on the unique characteristic of the industry. We will then take a closer look at ByteDance's core products in order to examine the accuracy of its current valuation.

The thesis is structured as follows.

In Section 2, theoretical background is provided. Three traditional valuation approaches are introduced and the widely used valuation methods as well as metrics are discussed. In Section 3, we introduce our methodology based on prior theories. Section 4 presents the research results followed by the analysis and discussion. In Section 5 we concludes our research. Discussions on the theoretical and practical implications of model, as well as potential opportunities for future research is also given in the section.

2 Theoretical Background

2.1 Traditional Valuation Methods

Internet companies exhibit unique characteristics that are fundamentally different from those of traditional industries. Companies in traditional industries are more dependent on factors of production, whereas Internet companies have more intangible assets.

Prior studies categorized the most used valuation methods into three main approaches: income, asset-based, and market approach (Kirk & Wishing, 2018; Saari, 2012). We discussed these three approach one by one and examined their suitability for valuing internet companies.

2.1.1 Income approach

Income approach values the company with a focus on its income statement or cash flow statement. One widely used method under income approach is discounted cash flow (DCF) method.

Under the DCF method, the value of a company is derived from discounting all of its expected future cash flows to the present value at a risk-free rate (Damodaran, 2019a). This is shown in equation (2.1).

$$V = \frac{CF_1}{\left(1+r_f\right)^1} + \frac{CF_2}{\left(1+r_f\right)^2} + \cdots + \frac{CF_n}{\left(1+r_f\right)^n} = \sum_{n=i}^{\infty} \frac{CF_n}{(1+r_f)^n} \qquad (2.1)$$

Where V denotes value, CF denotes projected cash flow, r_f denotes risk-free interest rate, n denotes time period from one to infinity.

However, in reality it is difficult to calculate values based on a time horizon of perpetuity. Equation (2.1) also does not take into account the cash growth every year (Nogueira Reis & Augusto, 2013). Thus, terminal value is introduced to simplify the calculation process. A common way to estimated terminal value is by incorporating Gordon Growth Model (GGM) – terminal value is given by dividing the multiplication of final year cash flow and long-term cash growth rate by the difference between risk-free rate and long-term growth rate of cash (Folger, 2018; Jennergren, 2008). This is shown in equation (2.2).

$$TV = \frac{CF_t * (1 + g)}{r_f - g} \tag{2.2}$$

Where TV denotes terminal value, t denotes the terminal year of the time period considered, g denotes long term growth rate for cash.

$$V = \sum_{n=1}^{t} \frac{CF_n}{(1 + r_f)^n} + \frac{TV}{(1 + r_f)^t} \tag{2.3}$$

Note that with TV being considered, n in equation (2.3) still denotes time period, but instead of one to infinity as in equation (2.1), it denotes time period from one to the terminal year (1 to t).

The DCF method is built on the assumption that the company is able to generate stable economic benefits in the future in the form of cash flow (Beqiraj & Davis, 2016; Dannible & McKee LLP, 2019). In our case, Douyin is a rather young company with only 7 years of history and its business model is yet to be proven profitable – it does not possess positive cash flows necessary for DCF calculation. Looking ahead, its future cash flow is subject to many factors that are macro-economic, political, industry-specific, and corporate, we therefore don't think DCF is a suitable method for valuing Douyin.

2.1.2 Asset-based approach

Asset-based approach values the company with a focus on its balance sheet. One widely used method under this approach is net asset value method. It derives values from the combination of fair market value (FMV) of the company's individual assets and is commonly performed when the company is under acquisition, liquidation, or audit under different accounting standards (Damodaran, 2019b).

Main procedures of the approach includes the definition of business ownership interest subject to valuation, definition of standard and date of the valuation, and evaluation of the total assets and liabilities (Kirk & Wishing, 2018).

In mathematically terms, net asset value method can be shown as:

$$V = \sum FMV_{asset} - \sum FMV_{liability}$$

(2.4)

Where V denotes the estimated value of the company.

Asset-based approach is most useful when valuing holding companies, asset-intensive companies such as banks and distressed entities that aren't worth more than their net tangible value (Dannible & McKee LLP, 2019). However, it relies heavily on historical acquisition cost of the assets, and does not take into account unrecorded intangible assets such as the company's employees, their knowledge and expertise, or its user base.

Internet companies are not as intensive in tangible assets – most of the company's assets are intangible, such as intellectual property, brand recognition and customer loyalty. Douyin is thus not very suitable to be valued under net asset value method.

2.1.3 Market approach

Market approach bases the value of the company on comparable publicly traded companies. The main mechanism of market approach is to find a publicly traded company ("the comparable") that operates

in the same industry, evaluate its key pricing or performance multiples, and compare them to the company that is being valued ("the company") (Meitner, 2006).

Market approach belongs to relative valuation and is suitable when valuing public companies or privates companies that are mature and large enough because of easy data retrieval. It reflects not only company value but also market perceptions, which are not covered by the other two approaches (Damodaran, 2019b). However, prerequisites for market approach do exist in order to ensure a fair comparison and valuation. One is to have a large data set that is readily available, the other is to have minimal difference between the company and the comparable. If these conditions are not satisfied, one could still value the company under the market approach, but the final estimation might be erroneous.

Main procedures of market approach includes definition, analysis, and application of the multiple.

A commonly used method under market approach is comparable company analysis. It would be introduced in more details in Section 3.

3 Method

3.1 User Growth Analysis

3.1.1 Discrete Growth Rate

The user growth rate of a company is often depicted by a differential equation:

$$\frac{dP}{dt} = r * P * (1 - \frac{P}{K})$$

(3.1)

Where P represents the user amount, r refers to the initial growth rate, and K refers to the maximum carrying capacity.

Equation (3.1) can be explained in a sense that exponential growth takes place at a rate of r when user amount P is much smaller than the maximum carrying capacity K, whereas the growth rate decreases by time and eventually stops when these two parameters, K and P, reach even – in other words, when the maximum carrying capacity is reached.

By rearranging terms in equation (3.1), we obtain a formula on continuous growth rate of users:

$$R_i^c = \frac{dP}{dt} * \frac{1}{P} = r * (1 - \frac{P}{K})$$

(3.2)

Where R_i^c depicts discrete growth rate, P represents the user amount, r refers to the initial growth rate, and K refers to the maximum carrying capacity.

Alternatively, one can also look at a company's discrete growth rate of users. The discrete growth rate refers to the amount of user growth between two points in time can be derived from the above equation:

$$R_i^d = \frac{\ln(\frac{P_i}{P_{i-1}})}{t_i - t_{i-1}}$$

(3.3)

Where R_i^d depicts discrete growth rate, i represents the point in time, t refers to the time period, and P_i refers to the user population at the time i.

Discrete growth rate model can be fitted into the continuous one, as proposed in prior studies by Cauwels and Sornette:

$$R_i^c = r * \left(1 - \frac{\frac{P_i + P_{i-1}}{2}}{K}\right) = \frac{\ln\left(\frac{P_i}{P_{i-1}}\right)}{t_i - t_{i-1}} = R_i^d$$

(3.4)

Expressing equation (3.3) as a linear function $y = ax + b$, y and x can be represented in terms of discrete growth rate, R_i^d, and user population from different time, $P_i + P_{i-1}$:

$$y = R_i^d$$

(3.5)

$$x = P_i + P_{i-1}$$

(3.6)

We can then express r and K accordingly,

$$r = b$$

(3.7)

$$K = -\frac{b}{a}$$

(3.8)

When plotting the time-series data of Douyin's user population along with its linear regression, we would obtain its discrete growth rate as a linear function in form of $y = ax + b$, thus obtaining values of a and b. From there we could calculate, under equation (3.7) and (3.8), to get the values of r and K.

3.1.2 Logistic Function

The growth rate is then incorporated into a logistic function to predict future user growth. Logistic function is important in understanding and depicting the evolution of user growth. It provides a means for predicting future user growth of Internet companies. Prior research has shown that the growth of user base follows the natural growth law, an S-shaped logistic curve (Cauwels & Sornette, 2012).

A standard logistic function is often written as:

$$f(x) = \frac{L}{1 + e^{-k*(x-x_0)}}$$

(3.9)

Replacing the parameters with user-growth specific ones, we get:

$$P(t) = \frac{K}{1 + e^{-r*(t-t_0)}}$$

(3.10)

Where t represents different time periods, P(t) represents the user amount over time, r refers to the initial growth rate, and K refers to the maximum carrying capacity.

Therefore, setting t=0, we get:

$$P(0) = P_0 = \frac{K}{1 + e^{-r*(t-t_0)}} = \frac{K}{1 + e^{rt_0}}$$

(3.11)

By rearranging the terms in the equation, we get:

$$e^{rt_0} = \frac{K}{P_0} - 1$$

(3.12)

Substituting equation (3.6) into equation (3.4), we get:

$$P(t) = \frac{KP_0 e^{rt}}{K + P_0(e^{rt} - 1)} \tag{3.13}$$

Once both values of r and K are known as well, the remaining unknown parameter, initial user population, P_0 can be derived by rearranging equation (3.13) for the specific time point i. Detailed explanations can be found in the original study by Cauwels and Sornette.

Equation (3.13) would be used later in this thesis to predict Douyin's user growth.

3.2 Comparable Company Analysis (CCA)

A comparable company analysis (CCA) is an often used method in relative valuation under market approach that estimates the value of the target company based on a comparison its financial metrics, usually in forms of value-to-earnings multiples, with those of other similar listed companies (Capital City Training & Consulting, 2011; Godek, McCann, Simundza, & Taveras, 2011). The comparable companies are often publicly traded companies, and they usually share similar value drivers and operate in the similar industry as the target company that is being analyzed (Meitner, 2006).

The steps of CCA consists of:
1. Finding comparable companies with similar business models or financial profiles that operate in the same or very similar industry
2. Collecting the operational and financial data of comparable companies – easier with publicly traded listed companies for their readily available data
3. Evaluating performance metrics and multiples of comparable companies
4. Analyzing the target company using the multiples of its peers
5. Validating the analysis with strengths and shortcomings

Most commonly used multiples include price-to-earnings ratio (P/E), price-to-sales ratio (P/S), enterprise value-to-sales ratio (EV/S), enterprise-to-earnings-before-interest-tax-depreciation-and-amortization ratio (EV/EBITDA) etc. These multiples are defined and their relevance for this thesis are discussed below.

Price-to-earnings ratio (P/E)

P/E is calculated by dividing market price per share to earnings per share from the most recent financial year. It is the most widely used earnings multiple and shows how much investors are willing to pay per dollar of earnings (Damodaran, 2019b).

$$\frac{P}{E} = \frac{market\ price\ per\ share}{earning\ per\ share\ (EPS)} \tag{3.1}$$

P/E is mostly used for companies that are generating positive earnings and stable profits. However, earnings of Internet companies tend to fluctuate a lot and not all Internet companies are earnings positive at their current stage (Essence Securities, 2018). Thus, P/E is thought not the best metric to use in valuing Douyin.

Due to their unique business models, user base and user stickiness are two very important performance indicator for Internet companies. Internet companies make a substantial amount of revenue from advertisements, and these two indicators relate directly to the amount of revenue the company would make that corresponding year (Essence Securities, 2018). In the case of Douyin, a higher number of daily or monthly active users and a higher ratio of DAU/MAU would make the app more attractive for advertisement providers because of potential wider exposure and higher visibility (Cuffe, Narayan, Narayanan, Wadhar, & Wang, 2018). Increasing ad display in turn drives revenue growth, which is then converted to a higher valuation. Moreover, sales value is thought to reflect and take into account market perception and sentiment, leading to a relatively small deviations over time (Klobucnik & Sievers, 2013). Another advantage of using sales as the metric is that it is less dependent on accounting methods and is thus considered to be more objective than earnings, which could be manipulated by the company management (Foye, 2008). Thus, when valuing Internet companies, sales-related metrics are often used, such as P/S and EV/sales.

Price-to-sales ratio (P/S)

P/S can be calculated by dividing market price per share by sales per share from the most recent financial year. Alternatively, by cancelling out the number of shares, one can obtain P/S by dividing market capitalization by total sales of the year.

$$\frac{P}{S} = \frac{market\ price\ per\ share}{sales\ per\ share} = \frac{market\ capitalization}{total\ sales} \tag{3.2}$$

P/S is often used for valuing companies that experience rapid growth of revenues but fluctuating, relatively little or even negative net income – it is suitable for valuing Internet companies that are yet to be profitable (Essence Securities, 2018). It shows how much investors value and are willing to pay for every dollar of the company's sales (McClure, 2019).

Enterprise value-to-sales ratio (EV/S)

EV/Sales is an expansion of P/S and is calculated by dividing company's enterprise value by its total sales. Enterprise value is the total market value of the company net of cash, it can be obtained by the addition of market value of equity and debt minus the company's cash position.

$$\frac{EV}{S} = \frac{MV_{equity} + MV_{debt} - cash}{total\ sales} \tag{3.3}$$

EV/Sales is usually perceived to be a better metric than P/S since it takes into consideration of the company's capital structure, including the company's long-term debt and cash position (Kenton, 2019). However, EV/Sales involves more steps and the information needed for obtaining EV is not readily available for all companies (Hargrave, 2019). When both companies in comparison are in the same industry and share a similar capital structure, EV/sales should result in a similar company valuation as P/S would.

Enterprise value-to-earnings-before-interest-tax-depreciation-and-amortization ratio (EV/EBITDA)

EV/EBITDA, also known as enterprise multiple, is a widely used metric in company valuation (Mauboussin, 2018). It is calculated as It is calculated as the company's enterprise value divided by its ETBITDA, which means the total market value of the company net of cash, divided by the its earnings before interest, tax, depreciation, and amortization (Damodaran, 2019b).

$$\frac{EV}{EBITDA} = \frac{MV_{equity} + MV_{debt} - cash}{earnings\ before\ interest, tax, depreciation, and\ amortization} \qquad (3.4)$$

EBITDA is a measure of the company's profits and is widely accepted and used in mergers and acquisitions (M&A) transactions and valuation analysis (Tracy & Tracy, n.d.). However, it does has its limits. EBITDA is subject to management manipulation and does not take into account other factors including the risks, working capital changes, or quality of earnings (Luciano, 2003). As Douyin is a private company, it is hard to obtain both its EV and EBITDA. Thus, we exclude the usage this multiple in future analysis.

In our analysis, P/S ratio is used as the valuation metric for the comparable company analysis.

4 Data and Analysis

Short video industry is experiencing rapid growth in recent years. As shown in Figure 4 and Figure 5, the number of users in the short video industry in China reached 501 million in 2018, a 107% increase from 2017; the fast growing user based create more demand in the market, pushing market size to 11.69 billion CNY in 2018, a 109.5% increase from the 5.58 billion in 2017.
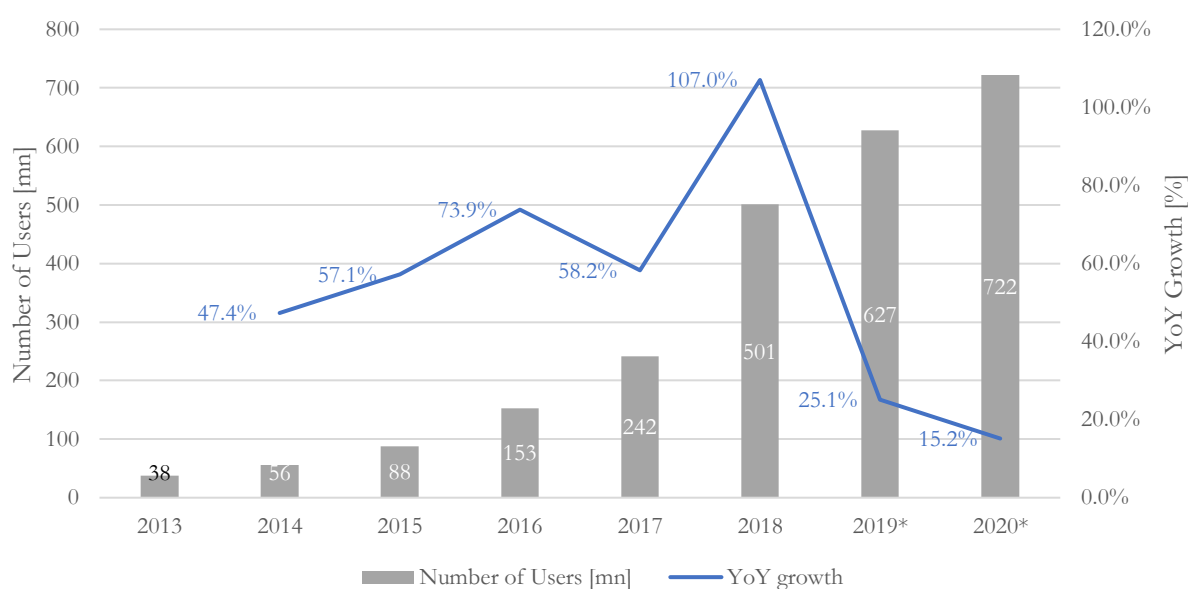

Figure 4: Number of users in the short video industry in China, 2013-2020[8]

Note: * represents estimates
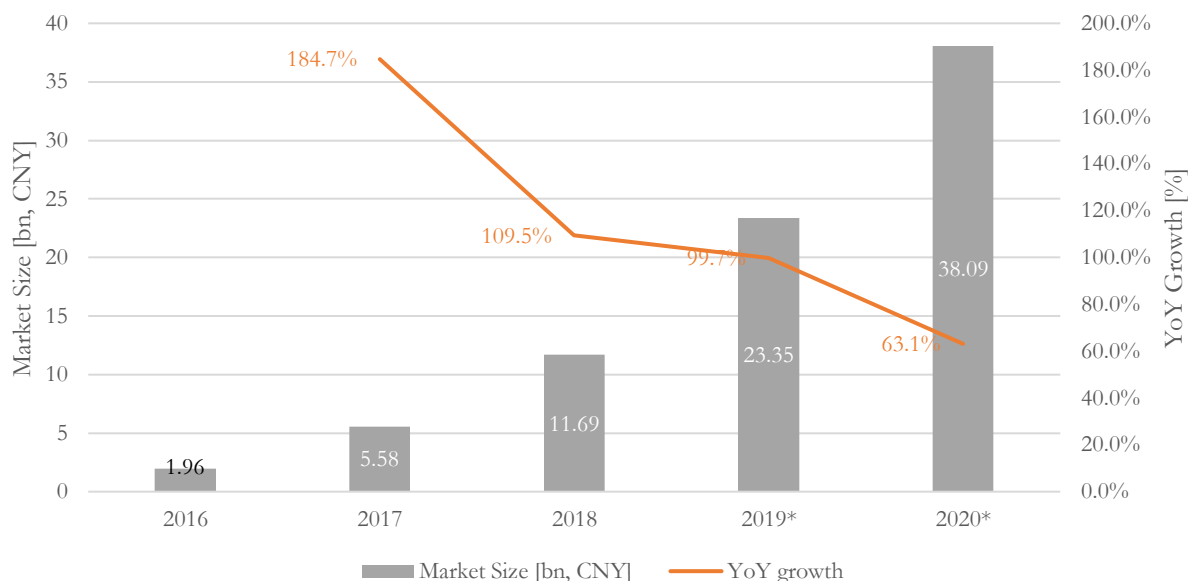
---

[8] Source: iiMedia Research Group

Figure 5: Market size of short video industry in China, 2016-2020[9]

Note: * represents estimates

However, as we can see from Figure 4 and Figure 5, even though both the amount of users and market size of the industry are growing over the last years, the growth is expected to continue at a much lower rate in the near future. The general market condition plays an important role in determining Douyin's future potential and would be discussed in later section.

4.1 Revenue Breakdown

To understand Douyin's current valuation and to forecast its future potential, it is essential to understand its cost and revenue model.

In this thesis, we propose that Douyin's revenue source can be broken down and summarized into the four following pillars:

---

[9] Source: iiMedia Research Group

1. Advertisement
   a. The main type of advertisement on traditional video platforms are pre-roll adverts. Pre-roll advertisements are sponsored video clips that are automatically displayed before the actual video content (Campbell, Mattison Thompson, Grimm, & Robson, 2017; Li & Lo, 2015). One main video could have several pre-roll ads of any length. However, due to the unique nature of short videos, advertisements before the each video would deteriorate user experience (Levy, 2017). The dominant types of advertisements on Douyin are, instead, initial app-opening advertisements and in-feed advertisements.
        i. Initial app-opening advertisements are, by literal means, displayed when users first open the app. It has the widest reach and can be displayed in three forms: images, gifs, and videos.
        ii. In-feed advertisements are displayed in user's news feed based on their specific portraits. They are shown in the form of short videos, equating content to advertisement, and are thus more widely accepted by users.

2. Online streaming / In-app purchase
   a. As short videos on Douyin are limited to a 15-second time constraints and means of interaction is limited to comments, Douyin now also supports live streaming. It is widely used by key opinion leaders (KOL), who in turn monetize by virtual gifts sent by their followers. Users purchase virtual gifts with virtual currency developed by Douyin, which can be loaded by and converted from real money.

3. Embedded e-commerce
   a. E-commerce platforms (e.g. Alibaba) are recently introduced into the Douyin app – a shopping cart icon is displayed at top right corner of the video, showing the items used or mentioned in the respective video. This development made it more convenient for users to purchase the items they are interested without exiting Douyin and opening the shopping app. This development is currently still in the testing phase and is only applicable to users with more than a million followers.

4. Online & offline interactive marketing / brand campaigns
   a. As a user generated content- (UGC-) centered social video platform, Douyin's characteristic cultivates a new type of advertisement. Major brands are now holding campaigns. With an award mechanism, these campaigns encourage and incentivize

users to produce and upload UGCs that are related to the theme of the campaign. This way, users help to spread the adverts even further and become a medium of communication. Brand images are then reinforced and products are promoted at an exponential speed.

All revenue sources are highly dependent on the amount of users and the traffic generated. Currently, Douyin's revenue streams mainly from advertisement display and campaigns (T. Chen, 2017). In-app purchase and linked e-commerce are premature and in the testing phase, respectively.

To put Douyin's revenue model into more mathematical language, we identified the following key parameters and summarized them in Table 1.

Table 1: Parameters used in assessment of Douyin's revenue model

Parameter	Definition
Daily ad traffic	The amount of views an ad receives per day[10]
Daily Active User (DAU)	The number of unique, engaged users per day[11]
Daily ad impressions per user	The number of ads viewed per day per user [12]
Unit price / Price per ad	The price for display the ad per unit, based on the ad type (CPM, CPT, CPC, etc.)
Ad load	The frequency of ad delivery, which is the ratio of ads to other main contents[13]

[10] Source: MarketingTerms, retrieved from

https://www.marketingterms.com/dictionary/web_site_traffic/

[11] Source: MixPanel, retrieved from https://mixpanel.com/topics/daily-active-users/

[12] Impression is counted when an ad enters the viewable area of the screen for the user. Note that there is no universal way in how impressions are counted – wide variety exist among different companies. Source: Facebook (https://www.facebook.com/help/publisher/1028565693903694 ， https://www.facebook.com/help/publisher/1995974274064245)

[13] Source: Recode, retrieved from https://www.recode.net/2017/7/15/15973750/facebook-ads-everywhere-instagram-messenger-whatsapp

We summarized Douyin's revenue components as well as the key parameters, and organized them into the equations below.

In-feed ad load

In-feed ad load refers to the ratio of advertisements to other contents in the feed (Wagner, 2017).

It can be calculated as the division of advertisements displayed by other contents.

$$In - feed\ ad\ load = \frac{amount\ of\ ad\ displayed}{amount\ of\ main\ content} * 100\% \qquad (4.1)$$

In-feed ad revenue

Initial app opening advertisements refers to the ones that are pushed and loaded when users open the app. Douyin charges on this type of advertisement on a cost per time (CPT) basis, where cost incurs on a fixed time basis, usually per day or per month.

In-feed ad revenue measures the amount of revenue generated by displaying advertisements in the feeds of Douyin. It is highly dependent on the exposure and is thus charged by the amount of views, as a proxy for the ad visibility. Douyin uses cost per mille (CPM), which refers to cost per thousand views; cost incurs as long as the advertisement is displayed.

It can be obtained by multiply daily advertisement traffic with unit price of advertisement display and the number of days in a year. Daily advertisement traffic can be calculated as DAU times daily advertisement impressions per user, which can then be obtained by the multiplication of daily usage per user in minutes, the number of videos displayed per minute, and Douyin's in-feed ad load.

A more straight forward way for this explanation is to convert it into mathematical formula.

$$In-feed\ ad\ revenue = daily\ ad\ traffic * unit\ price * 365$$

$$= DAU * daily\ ad\ impressions\ per\ user * \frac{CPM}{1000} * 365$$

$$= DAU * daily\ usage\ in\ mins * videos\ displayed\ per\ minute * in$$

$$- feed\ ad\ load * \frac{CPM}{1000} * 365$$

$$= DAU * daily\ usage\ in\ mins * videos\ displayed\ per\ minute$$

$$* \frac{amount\ of\ addisplayed}{amount\ of\ main\ content} * 100\% * \frac{CPM}{1000} * 365$$

$$* promotion\ factor\ of\ CPM \tag{4.2}$$

Initial app-opening ad revenue

Initial app opening advertisements refers to the ones that are pushed and loaded when users open the app. Douyin charges on this type of advertisement on a cost per time (CPT) basis, where cost incurs on a fixed time basis, usually per day or per month.

Here the revenue of initial app-opening advertisements can be calculated as the number of days in a year times the cost per day.

$$Initial\ app-opening\ ad\ revenue = daily\ ad\ traffic * unit\ price * 365$$

$$= number\ of\ rounds * CPT * 365 \tag{4.3}$$

Campaign revenue

Campaign revenue incurs on a per time basis – the cost is charged each time when a campaign is held.

It can be calculated by multiplying the number of campaigns held per year by cost per campaign.

$$Campaign\ revenue = number\ of\ campaigns\ held\ per\ year * unit\ price \tag{4.4}$$

4.1.1 Revenue Analysis

As ByteDance is a privately held company and does not publish or announce any of its income, we estimated its revenue on grounds of the main components. In order obtain a fair estimation, it is important to look at Douyin's pricing list, and the company's regime of charging on the placements of advertisements. Table 2 below describes and summarizes the most recent official pricing list published by Douyin.

Table 2: Pricing list for advertisements on Douyin app[14]

Product Type	Product Name	Location	Type of Advertisement	Cost Structure	Price	Unit	Remarks
Initial App-Opening	CPT	Initial screen at app opening	Stationary / Image	CPT	2,800,000	CNY/ day / round	Images/ dynamic gifs/ videos are displayed for 3/4/5 seconds, respectively
			Dynamic / Video		3,360,000		
	CPM		Stationary / Picture	CPM	200	CNY/CPM	
			Dynamic / Video		240		
In-feed	Single page	The 4th feed of the 1st/3rd/5th/7th swipe	Video of 5-30 seconds	CPM	240	CNY/CPM	Each swipe loads 6 UGC videos, ad is displayed at random at the 4th feed of the 1st/3rd/5th/7th swipe
	Native						
Campaign	-	In app	-	Cost per campaign	2,400,000	CNY / campaign	-

---

[14] Source: Bytdance, as of Q2 2018, http://toutiao.appun.cn/kanli/kanli.html

As discussed, we broke down Douyin's revenue stream to three main components: initial app-opening ad, in-feed ad, and campaigns. Calculations of each component along with the totaled sum are shown below in Table 3.

Table 3: Values of key parameters for ad and campaign revenue

Data	Value
Daily Active User (DAU) [mn]	150
Average Daily Usage Per User [min]	60
Number of video clips per minute	4
In-feed ad load	2.4%[15]
Cost per view (CPM/1000) [CNY]	0.24
Promotion factor for CPM	0.25
Number of days in a year	365
Estimated In-feed Ad Revenue [mn, CNY]	18,771
Cost per time (CPT) [mn, CNY]	2.8
Estimated Initial App-opening Ad Revenue [mn, CNY]	1,022
Number of campaigns	50
Cost per campaign [mn, CNY]	2.4
Estimated Campaign Revenue [mn, CNY]	120
Estimated Total Revenue [mn, CNY]	19,913

To make sense of the values given in Table 3, certain assumptions and explanations are made:

1. DAU is estimated at 150 million. According to third-party data from QuestMobile, the average DAU of Douyin in 2018 is calculated to be 137 million (QuestMobile, 2019).

2. Average usage per day per user is estimated to be 60 minutes. According to third-party statistics, the average usage of Douyin per day per user in 2018 averaged 52 minutes (Iqbal, 2019).

---

[15] Rounded value.

3. Video clips uploaded in Douyin are subjective to a time limit of 15 seconds. In reality the length may vary, as accounts that fulfill certain requirements can apply for extending the limit up to 60 seconds. However, for simplicity reason, here we assume all videos are of a length of 15 seconds, which gives us 4 video clips per minute.

4. In-feed ad load is calculated according to equation (4.4) and the remarks shown in Table 2.

$$In-feed\ ad\ load = \frac{amount\ of\ addisplayed}{amount\ of\ main\ content} * 100\% = \frac{1}{6*7} * 100\% \cong 2.4\%$$

5. Per definition, CPM incurs for every thousand views. Therefore, cost per view is calculated to be 0.24 CNY.

6. Table 2 shows the official pricing for advertisement for Douyin. However, promotion factor is usually applied in reality. Multiple sources have disclosed that the actual CPM for Douyin deviates from the official listing, we assume here that the actual CPM currently at 60 CNY ($ 8.6)[16], giving us a promotion factor of 0.25. As shown in Figure 6, the average CPM worldwide for social media at the end of 2018 is at the level of 6.52 USD, which is roughly 46 CNY[17], showing that 60 CNY is within reasonable range and is rather at the higher end of the pricing. We give this 30% premium the price because of Douyin's increasing popularity and rapid growth of MAU – they offer higher bargaining power as more brands and commercials would like to place ads there to increase exposure and visibility. Thus giving Douyin the power to ask for a possibly higher price. Thus, the promotion factor of 0.25 is used here for further calculation.

7. It is assumed to be 365 days in a year. Leap years, which are calendar years with 366 days, are not considered separately here.

8. Initial app-opening ad is assumed to be requested and displayed all days around the year, with no break.

9. We assume 50 campaigns are held per year by Douyin.

---

[16] Disclosed by internal staff of Douyin to media.

[17] In this thesis, the foreign exchange rate for USD/CNY is assumed to be fixed at 7(1 USD = 7 CNY, 1 CNY = 0.14 USD), long-term, unless otherwise stated.

The final revenue derived in Table 3 was largely based on the assumptions made. Values might vary in reality. In later section, we addressed all parameters separately to examine their impact to Douyin's future revenue growth and valuation.
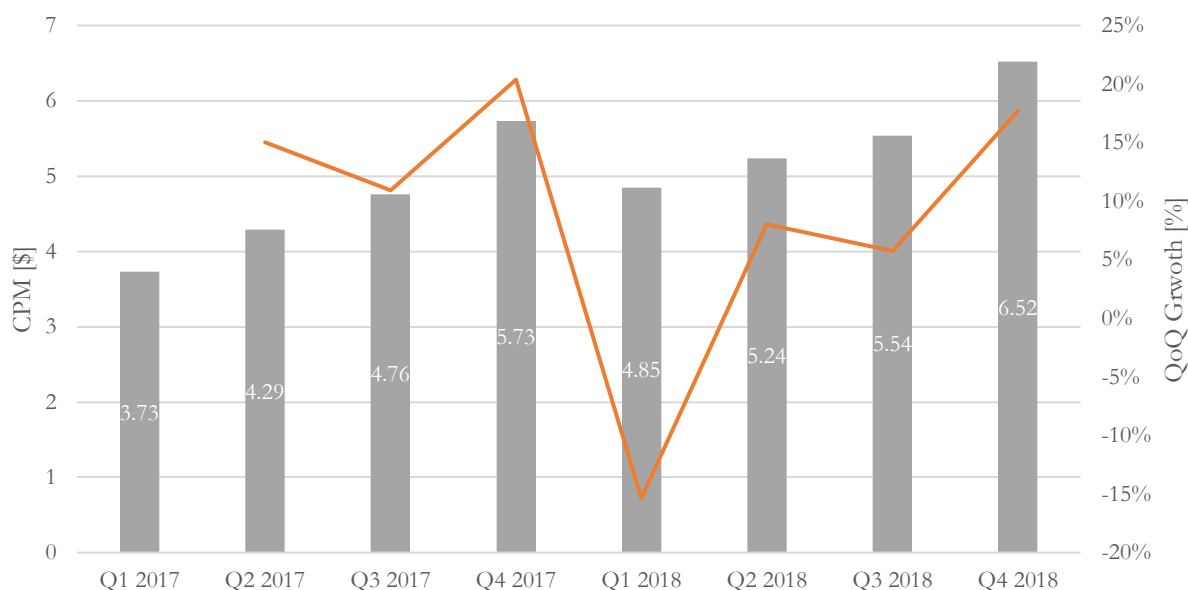

Figure 6: Social media advertising cost-per-mille (CPM) worldwide from Q1 2017 to Q4 2018 [USD][18]

4.1.1 Revenue Projection

We studied both the general market trend and company/app-specific variables to access the potential growth of Douyin's ad revenue in the future.

Macro market trend – short-video industry

On one hand, looking at the entire short video industry as a whole – despite the market is in general growing in size, we see trend of decreasing proportion of revenue from the advertisements.

---

[18] Source: Statista

Shown in Figure 7, revenues of the short video in industry in China are categorized into four main groups based on the sources:

1. Revenue from advertisement
2. Revenue from paid content
3. Revenue from copyright distribution
4. Revenue from other sources

It is not hard to see that the proportion of revenue from advertisements decreased from 73.4% to 50.9% in 2016, and this percentage is expected to stay rather static in the following years. Revenue from paid content is, however, gaining its space – it has been increasing over the years and the trend is expected to continue in the future.

A very large percentage of Douyin's revenue comes from advertisements. If we go back to the macro market environment, Figure 5 shows that the estimated growth of market size in the upcoming years – we can see from the graph that the growth is slowing down, with a year-on-year growth of 99.7% in 2019 and 63.1% in 2020. Combining messages behind these two figures, we can conclude that revenue from advertisement is expected to grow at the same pace as the entire short video industry in the following years.

So far, there exist no premium account or feature in Douyin, the revenue from paid content solely lies on in-app purchase of virtual gifts from viewers and followers to live streamers. Living streaming is a feature in Douyin that is still in the development stage. It faces intense competitions from existing market-leading live-streaming apps such as Douyu, Inke, and Yizhibo – Douyin's live-streaming feature is yet to be mature.

As the majority of the content on Douyin are UGC and is available to be shared freely to other platforms, the company currently has no revenue from copyright distribution. This is expected to continue in the near future as ByteDance does not own any of the contents.

Thus, instead of sharing the market dividend from the industry growth, it is thought that Douyin's future growth would be more dependent on the development of company- and app-specific parameters.
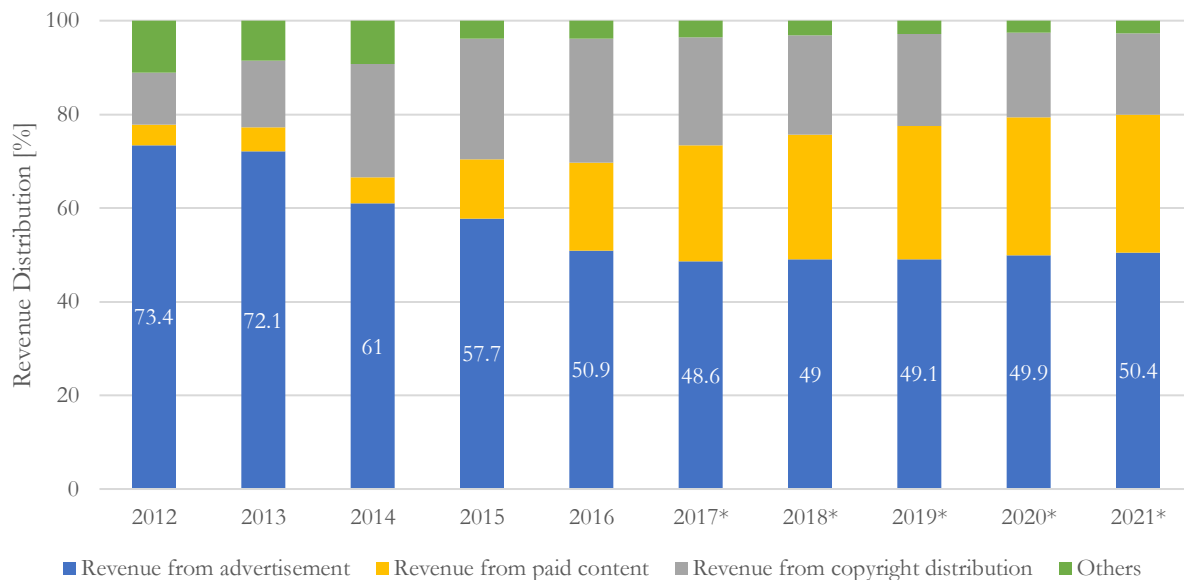
Figure 7: Revenue distribution in the online video industry in China up to 2021[19]

Micro company trend – Douyin

On the other hand, we identified five parameters that are key to Douyin's in-feed ad revenue, which makes up a substantial amount of the company's total revenue.

1. Daily active user (DAU)
2. Daily active usage per user
3. Number of video clips per minute
4. In-feed ad load
5. Promotion factor

We examined these parameters separately carefully on the its possible variations in future and its impact on Douyin's revenue growth.

---

[19] Source: Statista

Daily active user (DAU)

Looking at the macro environment, we could observe that, as shown in Figure 8, the penetration rate of mobile internet in China has reached 98% in 2017 – 98 out of 100 internet users are users of the mobile internet. This is over four folds of the penetration rate back in 2007, which was only 24%. This huge amount of increase indicates the fast development of Chinese economy and the increasing degree of Internet coverage but also shows that the future growth is very limited.

More specifically, if we look at the MAU of mobile Internet in China, we can see that the number is still growing but at a slower speed, as compared to the same period last year even much slower to the year before last year. As depicted and shown in Figure 9, the annual net gain of MAU was 61 million in 2017 and 43 million in 2018. Looking at the growth rate, the year-on-year growth of MAU at the end of 2018 is below 4.2%, whereas that of the end of 2017 and 2016 were 6.3% and 17.1%, respectively. The dramatic decrease in the growth rate of MAU also indicates that the market has reached the mature stage, potential increase in the future is restricted.
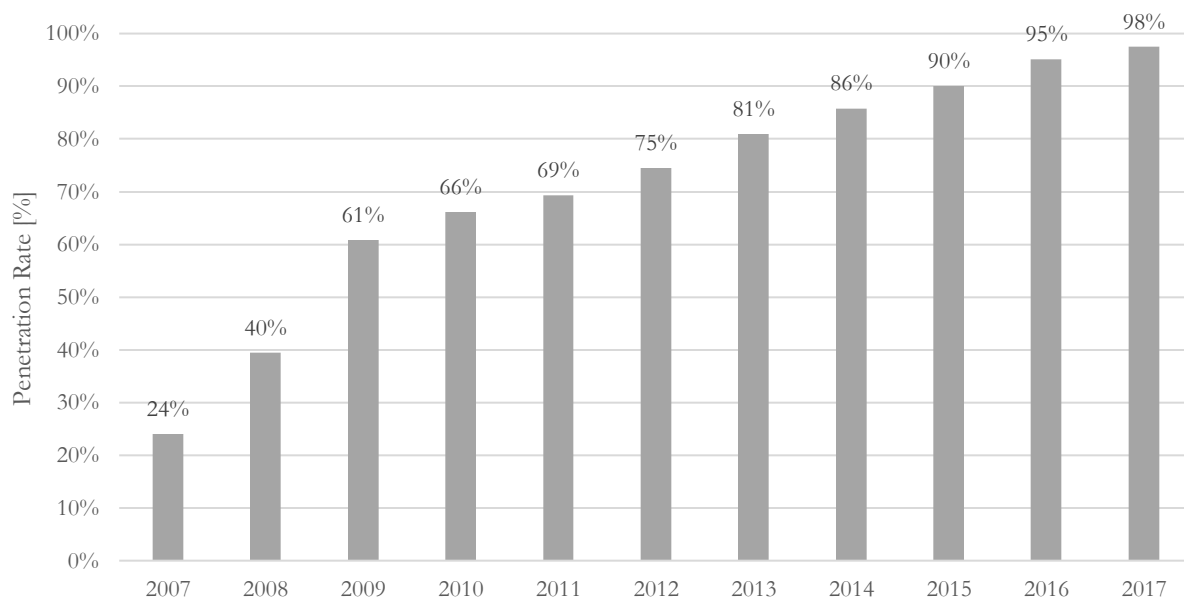

Figure 8: Penetration rate of mobile Internet in China, 2007-2017[20]
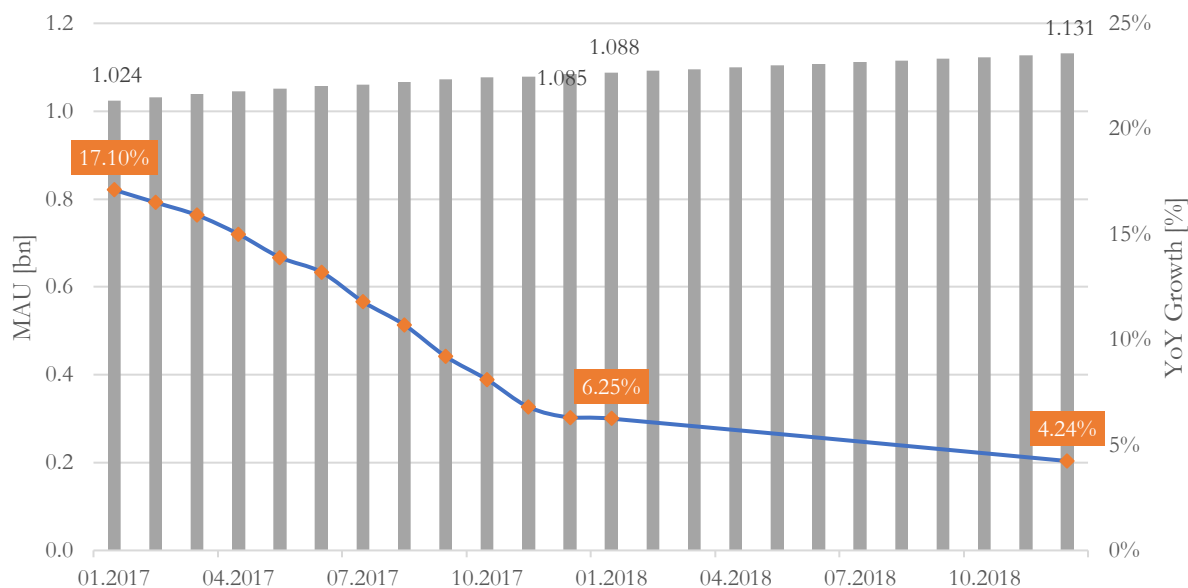
---

[20] Source: Statista

Figure 9: Development of Monthly Active Users (MAU) of mobile Internet in China, 2017-2018[21]

Note: MAU data from 02.2018 to 11.2018 are interpolated for illustration purposes

If we take a closer look at Douyin's user data, we can see that, shown in Figure 10, the growth of its MAU has been slowing down. Ever since June 2018, the growth rate has been fluctuating within the range of 2% to 10% – it is not hard to see that Douyin's user growth has stagnated.

---

[21] Source: QuestMobile Research Institute, *QuestMobile: 2017 & 2018 China Mobile Internet Report*
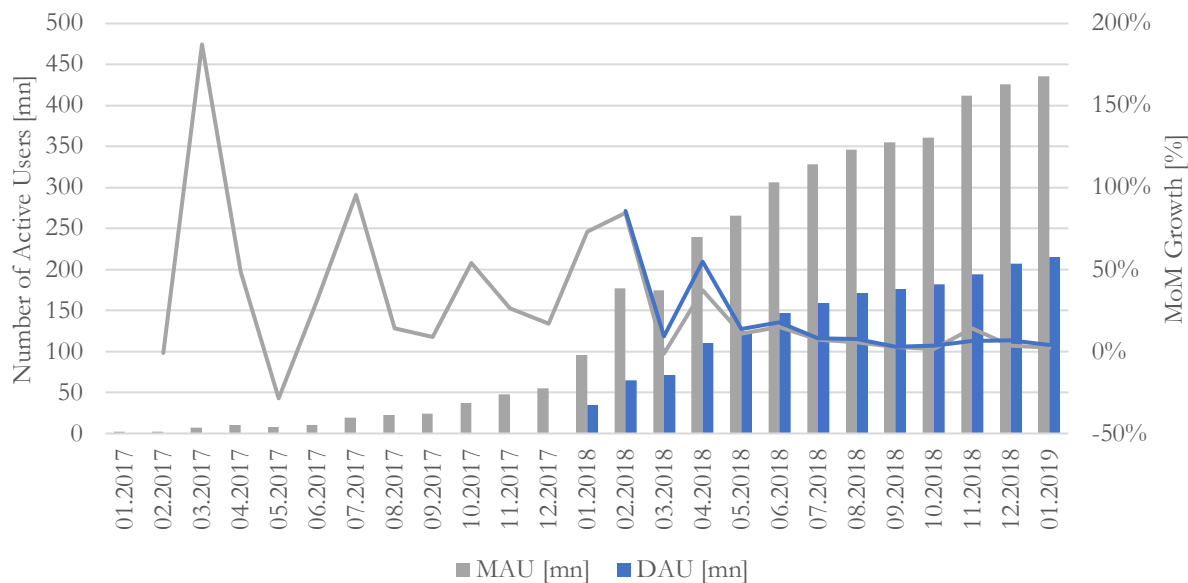
Figure 10: Development of monthly and daily active user of Douyin in China, 2017 – 2019, in millions[22]

To give more context about the industry, we looked at the user development of Weibo and Facebook. We chose these two companies as they are both one of the social media giants – Weibo provides insight of the Chinese market whereas Facebook reflects the trend overseas.

Figure 11 and Figure 12 show the user development of Weibo and Facebook since they went public in 2014 and 2010, respectively. We can see that both Weibo and Facebook have been experiencing a rather steady growth of MAU over the years. The growth rate fluctuates in a very similar range of Douyin. In 2018, Weibo's MAU growth rate averaged around 5%. For Facebook, the trend is more obvious, as the data available for Facebook's user development spans a longer time horizon. We see that the growth rate of MAU has significantly lowered since 2014. Over the past four years, Facebook's MAU growth rate has fluctuated with the range of 2% to 5%. This reinforced our assumption that the rapid growth phase is over, Douyin has reached a rather mature stage in its user development.

---

[22] Source: QuestMobile, retrieved from https://www.questmobile.com.cn/research/report-new/58, http://www.sohu.com/a/298518542_100005778
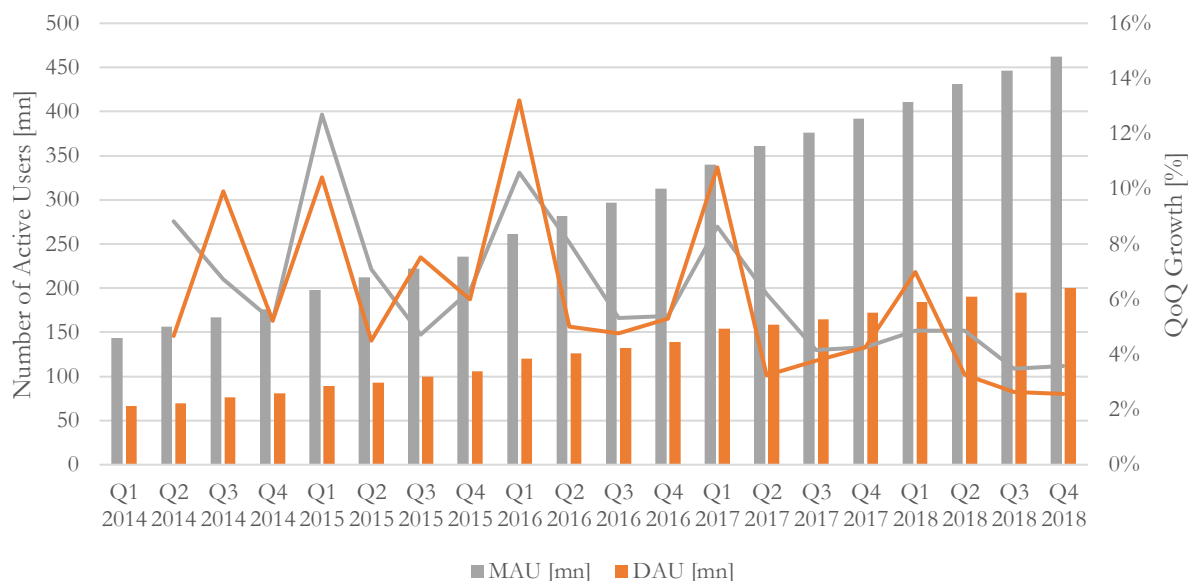
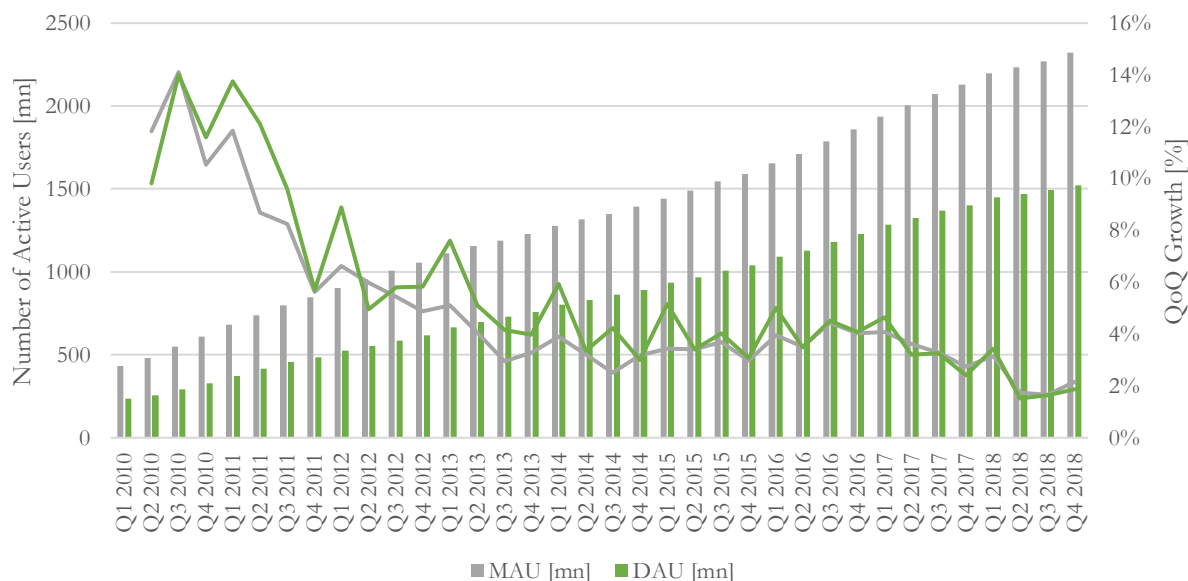Figure 11: Development of monthly and daily active user of Weibo worldwide, 2014 – 2018, in millions[23]

Figure 12:Development of monthly and daily active users of Facebook worldwide, 2010 – 2018, in millions[24]

[23] Source: Weibo Annual Report, 2014 - 2018

[24] Source: Facebook Annual Report, 2010-2018

Alongside MAU growth, there is also one important metric in determining the potential growth of DAU – user stickiness. User stickiness refers to user's willingness to return to and repeatedly use the product (Chiang & Hsiao, 2015). In other words, it shows the frequency of user engagement of on certain product. To put it in a quantifiable term, user stickiness can be explained by the ratio of DAU to MAU (DAU/MAU) – the proportion of monthly users who use the product on a daily basis. A DAU/MAU of 50% means that on average, users use the app 15 days out of a month; a DAU/MAU of 100%, with the same principle, then reflects the every-day usage of the app in a month.

Figure 13 depicted the development of user stickiness of Douyin, Weibo, Facebook, and Douyin's biggest competitor in China – Kuaishou. We observe that the user stickiness of the two short video apps are clearly lower than Facebook, but are slightly higher than Weibo. However, as Facebook and Weibo has been established for a longer time period thus are at a rather mature stage, it makes limited sense to compare Douyin with them – though it gives an overview on the industry.
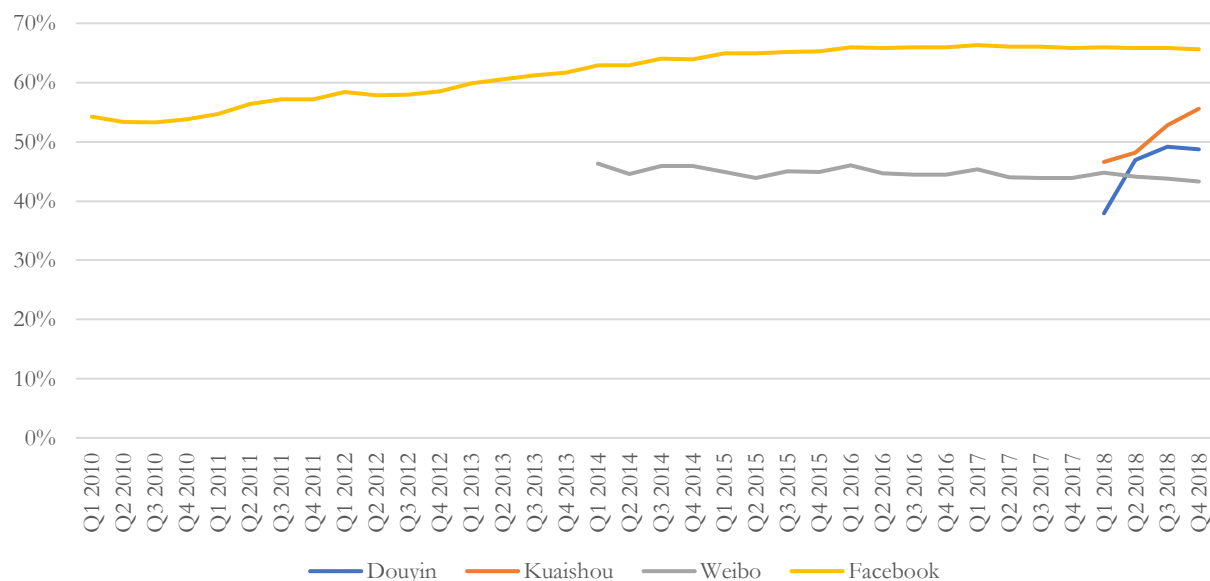

Figure 13: Development of user stickiness of Douyin, Kuaishou, Weibo, and Facebook [25]

Zooming in to look closer into the two competitors, Douyin's users seem to be less 'sticky' than Kuaishou – users of Kuaishou use the app on more days than those of Douyin do. Founded in 2011

as a photo-sharing app, Kuaishou later pivoted into a platform that allows users to create and share short videos. Backed by the tech giant Tencent, Kuaishou also has a gaming interface and allows users to play mini-games within the app without downloading and registering for another stand-alone app separately (Huang, 2018). Serving almost the same function with highly similar features, Kuaishou and Douyin has a large amount of overlapping users. By December 2018, Kuaishou sported a MAU of 285 million (QuestMobile, 2019). Kuaishou's business model is also very similar to Douyin, with advertising as the substantial part of its revenue. We therefore think Kuaishou is a good proxy to compare Douyin's user stickiness to.

From Figure 14 we can see that Douyin's user stickiness has been around 48% for most of the 2018 and shows no sign of improvement. As said, user stickiness is critical in social media as it reflects the actual engagement level, which can also be seen as customer's loyalty. The flat curve of Douyin's user stickiness also implies that the user growth is very likely stagnated at its current status.
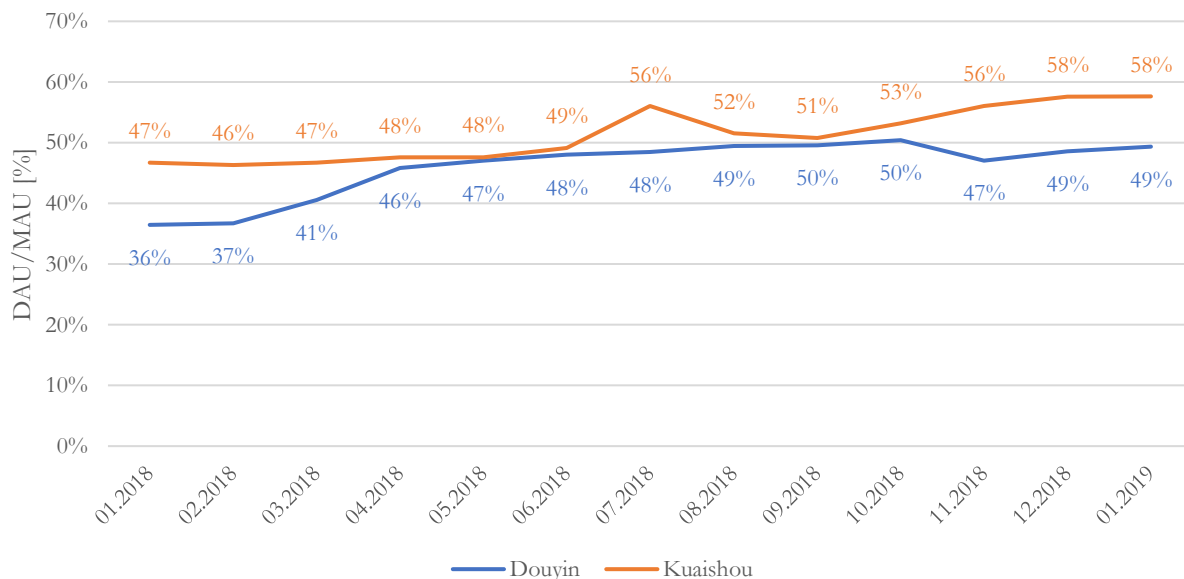

Figure 14: Development of user stickiness of Douyin and Kuaishou, 2018-2019[26]

We projected Douyin's future growth of MAU and DAU to support and justify the argument. The result is shown in Figure 15 below.

---

[26] Source: QuestMobile

The latest user data available on Douyin is of January 2019. As discussed, we think that its user growth is entering the phase of stagnation. Thus we assume that the MAU in future would grow at a rate that is 0.1% lower than the rate of last month – MAU growth rate of March 2019 is set to be 1.9% while MAU of February grew 2.0% compared to January. With this trend, its growth rate would be flat at 0% on September 2020. From there, the user growth would stop, if not decrease.

We assume the user stickiness of Douyin would stay constant 50% in perpetuity. With projected DAU and assumed static DAU/MAU, DAU growth is also projected.
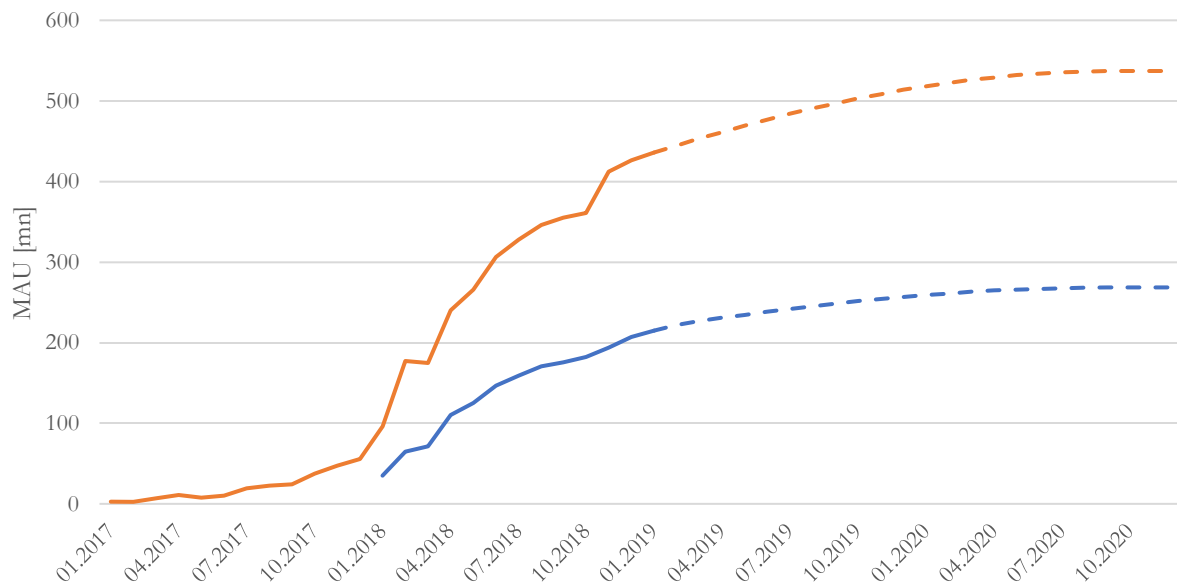

Figure 15: Projected growth of MAU and DAU of Douyin, in millions[27]

Note: solid line represents actual data collected and reported by a third-party data provider, QuestMobile, whereas dashed line represents future MAU projected under our assumption that the growth rate of MAU would gradually decline to 0%

We then calculated the average MAU and DAU for Douyin from January 2019 to December 2020, where the growth became flat. The values sported 505 million and 243 million, respectively.

Thus for revenue projection, we consider average DAU to be fluctuating between 200 and 300 million.

---

[27] Source: QuestMobile

Besides the arbitrary estimation, we also employed another method – calibration with the help of logistic function, to forecast Douyin's user growth in the future.

As shown in Figure 15, Douyin exhibits strong historical growth. To better understand the company's potential growth, we extended the methodology proposed in prior research by Cauwels and Sornette here to Douyin and incorporated the concept of discrete growth rate.

We plotted Douyin's discrete growth rate against its MAU over time to see the fit of data as well as to obtain values of initial growth rate r, and its maximum carrying capacity K.
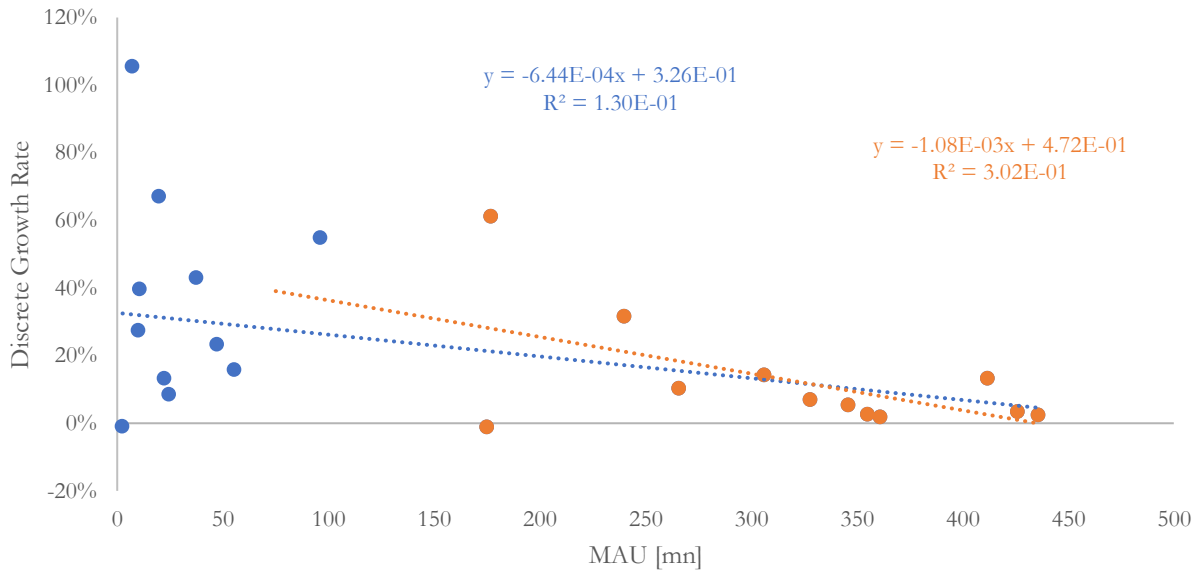

Figure 16: Discrete growth rate as a linear function of Douyin's MAU

Note:

1) Blue series covers data from Feburary 2017 to January 2019, blue dots represent data points over time whearas the dotted line depicts the discrete growth rate as a linear function of Douyin's MAU – $y = -6.44E - 04x + 3.26E - 01$ with an R-square of 0.13. This gives us $a = -6.44 * 10^{-4}$ and $b = 3.26 * 10^{-1}$.

2) Orange series covers data from Feburary 2018 to January 2019 – data from year 2017 was excluded here as it was the period of extreme user growth. Exclusion of such data might smooth the data and offer a better fit thus a more reasonable predictions into the future. Orange dots represent data points over time whearas the dotted line depicts the discrete growth rate as a linear function of Douyin's MAU – $y = -1.08E - 03x + 4.72E - 01$ with an R-square of 0.30. This gives us $a = -1.08 * 10^{-3}$ and $b = 4.72 * 10^{-1}$.

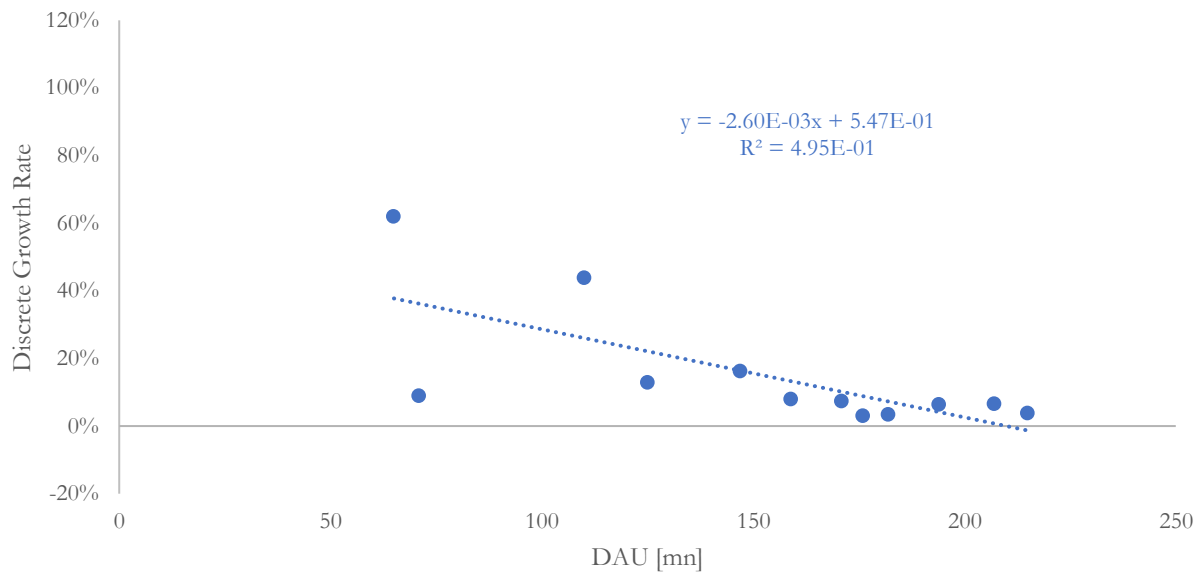We then repeated the same procedure on Douyin's DAU data.

Figure 17: Discrete growth rate as a linear function of Douyin's DAU

Note: For DAU, data is only available from Feburary 2018 to January 2019. Dots represent data points over time whearas the dotted line depicts the discrete growth rate as a linear function of Douyin's DAU – $y = -2.60E - 03x + 5.47E - 01$ with an R-square of 0.50. This gives us $a = -2.6 * 10^{-3}$ and $b = 5.47 * 10^{-1}$.

From Figure 16 and Figure 17, we observed the following:

- By showing discrete growth rate as a function of Douyin's user population, in terms of both MAU and DAU, we get a linear equation $y = -6.44E - 04x + 3.26E - 01$ for MAU and $y = -2.60E - 03x + 5.47E - 01$ for DAU. The R-square of both functions is low, being 0.13 and 0.50 respectively, suggesting that there is a low degree of fit from a linear decreasing discrete growth rate and the data points, reflecting user population over time.

- In Figure 16 , by excluding the period, year 2018, where Douyin experienced the most rapid user growth, we hope to smooth the data and obtain a better fit of the linear equation, in terms of higher R-square. However, as shown in the graph, for MAU, the R-square only increases from 0.13 to 0.34, not showing great improvement.

- The analysis of discrete growth rate reflects the level of fit of the logistic function. A linearly decrease of discrete growth rate as a function of user population reflects a well fitted logistic

curve (Bozovic, 2017). In our case, the outlying data points and the low R-square suggest that the logistic function might not be the best method to predict the future growth of Douyin.

However, the low degree of fit does not necessarily discredit the use of logistic function in this case, as there exist several reasons that this might occur:

- o Data points are from different sources, and the data is from second hand sources, not from the company directly, therefore the data is not 100% accurate.
- o Even though the fit is not perfect, we will still assume that logistic function is a valid method to predict the future user growth for the company.

From Figure 16 and Figure 17, corresponding values for initial growth rate, r, and maximum carrying capacity, K, can be derived. They are calculated and shown in Table 4 below. We consider these values as parameters for the base scenario of the Douyin's growth.

Table 4: Results from linear regression of discrete growth rate against user population of Douyin

			MAU	DAU
a	Multiplication factor	-	$-1.08*10-3$	$-2.60*10-3$
b	Constant	-	$4.72*10-1$	$5.47*10-1$
r	Initial growth rate per annum	b	0.472	0.547
K	Maximum carrying capacity	-b/a	437	210

Apart from the base growth we also considered and modeled two other growth scenarios, which we call high growth and extreme growth. Values of parameters used in these three different growth scenarios can be seen in Table 5.

Table 5: Parameters used in different scenarios

Data Set	Scenario	r [p.a.]	K [mn]
MAU	Base case	0.472	437
	High growth	0.326	506
	Extreme growth	0.301	700
DAU	Base case	0.547	210
	High growth	0.523	250
	Extreme growth	0.485	300

From Table 5 we get the following growth prediction on Douyin's MAU and DAU.
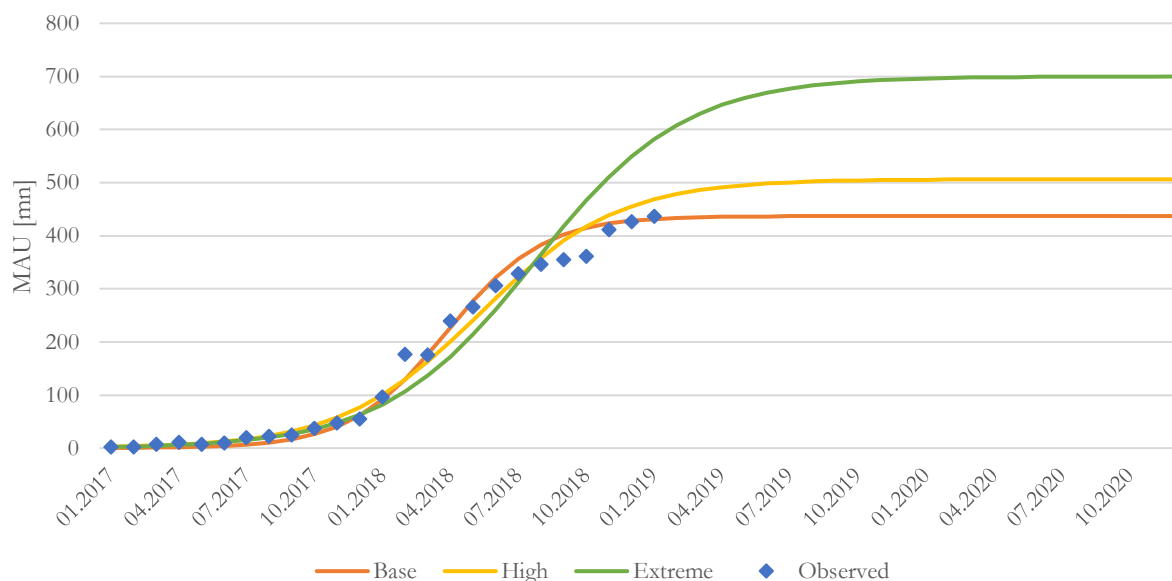
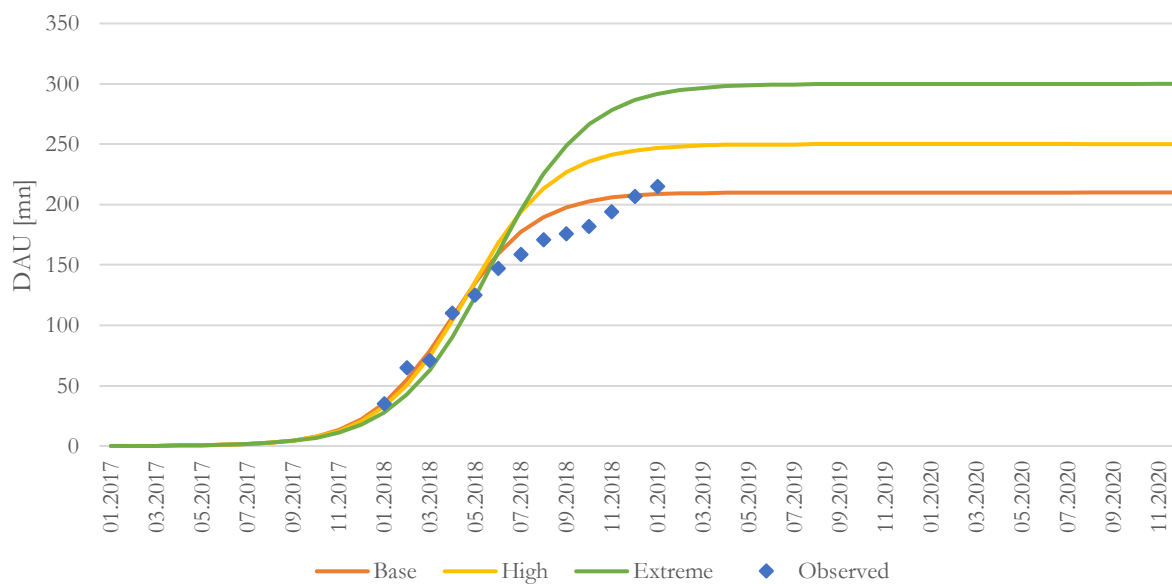Figure 18: Growth prediction on Douyin's MAU under three scenarios

Figure 19: Growth prediction on Douyin's DAU under three scenarios

If one take into consideration different scenarios and integrate the date with the revenue model shown Table 3, we would get the following estimated revenue for Douyin – assuming all else are constant.

Table 6: Estimated sales revenue of Douyin based on different growth scenarios

Scenario	DAU	Estimated Revenue [mn, CNY]
Base case	210	27,422
High growth	250	32,428
Extreme growth	300	38,685

Daily usage per user

In our analysis of Douyin's in-feed ad revenue, we estimated the average daily usage per user to be 60 minutes. We made the assumption based on the third-party statistic that claims the daily usage per user averaged 52 minutes. However, this number varies among different data providers.

As shown in Figure 20, daily usage of short video apps per user in China averaged around 32 minutes in the past four quarters (Q4 2017 – Q3 2018), according to iResearch. Assuming all usage of the short video apps originated from Douyin, this is still a vast different number with what was reported on Business of Apps – 52 minutes. Note that there exist also numerous competitors in the market, such as Kuaishou, Miaopai, and Weishi – these apps also contribute to the aggregated usage recorded.
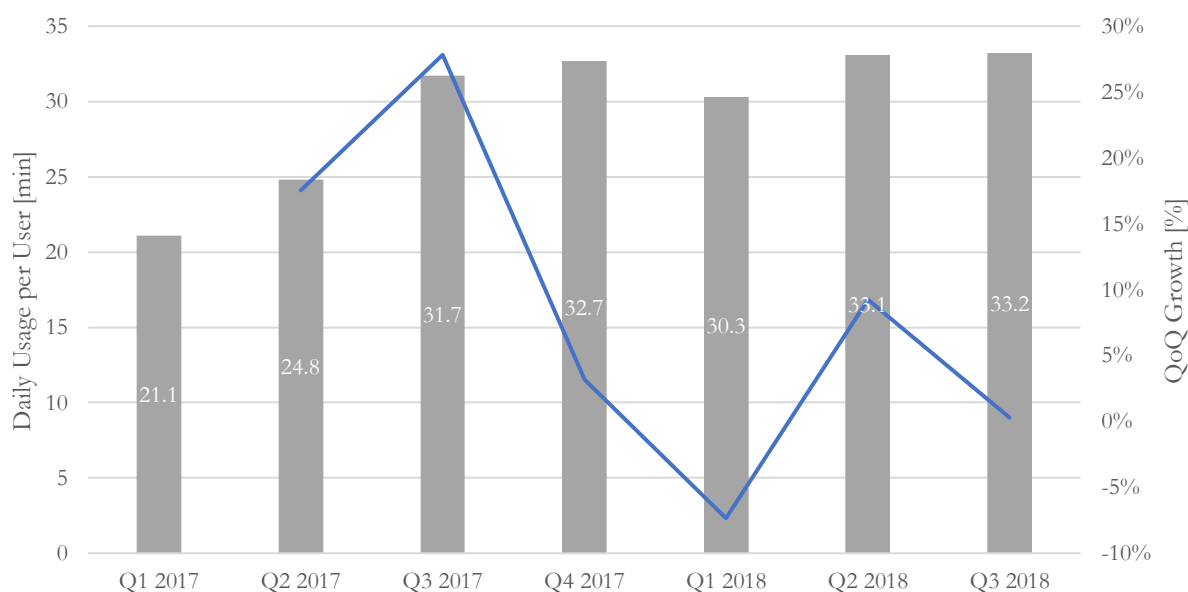

Figure 20: Daily usage of short video apps per user in China, from Q1 2017 to Q4 2018[28]

---

[28] Source: mUserTracker, iResearch; https://36kr.com/p/5168652

Given all videos are subjective to the 15-second time limit in Douyin, 32 and 52 minutes would be equivalent to 128 and 208 full clips, respectively. Due to this specific characteristic of the app, we foresaw limited increase of this variable thus neglect its impact in the following analysis.

Thus for revenue projection, we set the lower and higher bounds to be 30 and 60 minutes.

Number of video clips per minute

So far, almost all videos created in and posted on the Douyin platform are under the strict 15-second rule – they must not be more than 15 seconds in length. However, videos of too short length usually have limited ability to tell a story – thus, according to our observations, most videos are around 10 seconds long. Exceptions could be made for accounts with over 1,000 followers and a history of premium UGC, in such cases videos can be up to 60 seconds in length[29]. However, this is not a common feature – we do not consider it as a determinant factor in assessing Douyin's potential revenue growth. Although there is a possibility that these accounts would become more common, leading to more longer videos.

For revenue projection, we consider the number of video clips per minute to be in a range of 1 to 6 – videos are assumed to be in a length range of 10 to 60 seconds.

In-feed ad load

Ad load is defined as the ratio of ads to other contents and plays an important role in driving revenue growth of social media companies (Wagner, 2017), examples include Facebook in the Western industry and Weibo in the Eastern market. However, a high ad load poses the risk of losing viewers as it would greatly reduce user experience. Reports has shown that, for instance, Facebook maxed out their ad load around 2017 (Peterson, 2017). In an extremely competitive market, one that Douyin is

---

[29] There is no clear or uniform standard for premium content. Some define it as a 15-second clip with no less than 500,000 likes, some with no less than 1,000,000 likes – as said, there is no uniform standard, the application for eligibility is viewed on case by case basis.

currently in, a dramatic increase in ad load might cause users to switch to other platforms that are more content-friendly. Thus, we consider in-feed ad load a critical factor on Douyin's ad revenue growth. From its current ratio of 2.4%, we think there is quite some space for an increase, though a conceptual cap exists.

For revenue projection, we consider the possibility of ad load both increasing and decreasing, thus we left space for both fluctuations and set the limits at 1.6% and 4.0%.

Promotion factor

Promotion factor is crucial in determining the ad revenue as they share a proportional relationship. Right now, Douyin's promotion factor is at 0.25 – giving a CPM of 60, which is at a higher end of the industry average, according to Figure 6. However, given Douyin's large user base, industry-leading position, and the growing market, we believe that the promotion factor is likely to increase, leading to a higher CPM in the future. However, in order to remain competitive in the advertisement market, Douyin has to set the promotion factor within a reasonable rang, because too high of a promotion factor might not be beneficial as too high price would incentivize ad providers to switch platform.

For revenue projection, we consider the actual CPM, after applying promotion factor to the listed price, to be in a range of 30 to 90 CNY – covering a wide spectrum around industry's average CPM, as shown in Figure 6. This is after taking into account that the price increase and decrease ought to happen at a rather similar odds around industry standards.

To conclude the discussion above, after studying all parameters in Table 3 in detail, we determined the two key parameters that would be the most critical to the future growth of Douyin's in-feed ad revenue – in-feed ad load and promotion factor of CPM. They are thought to be the key revenue drivers for Douyin's revenue in the foreseeable future.

$$Actual\ CPM = promotion\ factor * official\ listed\ CPM \qquad (4.4)$$

We ran a sensitivity analysis of these two key revenue drivers – by varying the input value of the two variables, we obtained different output values on in-feed ad revenue. Note that actual CPM is used here instead of promotion factor to take into account possible fluctuations on listed price too.

Table 7: Sensitivity analysis on in-feed ad revenue of Douyin, with variables 1) actual cost of ad display in the form of actual CPM, considering listed CPM and promotion factor 2) in-feed ad load[30]

Annual In-feed Ad-revenue [mn, CNY]		In-feed Ad-load [%]												
		1.6%	1.8%	2.0%	2.2%	2.4%	2.6%	2.8%	3.0%	3.2%	3.4%	3.6%	3.8%	4.0%
Actual CPM	30	6,307	7,096	7,884	8,672	9,461	10,249	11,038	11,826	12,614	13,403	14,191	14,980	15,768
	35	7,358	8,278	9,198	10,118	11,038	11,957	12,877	13,797	14,717	15,637	16,556	17,476	18,396
	40	8,410	9,461	10,512	11,563	12,614	13,666	14,717	15,768	16,819	17,870	18,922	19,973	21,024
	45	9,461	10,643	11,826	13,009	14,191	15,374	16,556	17,739	18,922	20,104	21,287	22,469	23,652
	50	10,512	11,826	13,140	14,454	15,768	17,082	18,396	19,710	21,024	22,338	23,652	24,966	26,280
	55	11,563	13,009	14,454	15,899	17,345	18,790	20,236	21,681	23,126	24,572	26,017	27,463	28,908
	60	12,614	14,191	15,768	17,345	18,922	20,498	22,075	23,652	25,229	26,806	28,382	29,959	31,536
	65	13,666	15,374	17,082	18,790	20,498	22,207	23,915	25,623	27,331	29,039	30,748	32,456	34,164
	70	14,717	16,556	18,396	20,236	22,075	23,915	25,754	27,594	29,434	31,273	33,113	34,952	36,792
	75	15,768	17,739	19,710	21,681	23,652	25,623	27,594	29,565	31,536	33,507	35,478	37,449	39,420
	80	16,819	18,922	21,024	23,126	25,229	27,331	29,434	31,536	33,638	35,741	37,843	39,946	42,048
	85	17,870	20,104	22,338	24,572	26,806	29,039	31,273	33,507	35,741	37,975	40,208	42,442	44,676
	90	18,922	21,287	23,652	26,017	28,382	30,748	33,113	35,478	37,843	40,208	42,574	44,939	47,304

As we can see from

We ran a sensitivity analysis of these two key revenue drivers – by varying the input value of the two variables, we obtained different output values on in-feed ad revenue. Note that actual CPM is used here instead of promotion factor to take into account possible fluctuations on listed price too.

Table 7, our current assumptions put the in-feed ad revenue at a level of 18,771 million CNY (It is shown in the table as 18,922 as we used rounded value 2.4% for calculation instead of 2.38% as used

---

[30] Resulted ad revenue were calculated with the equation (4.2).

in actual estimation in Table 3). Following the discussion before, in-feed ad load and promotion factor of CPM, the two key revenue drivers for Douyin, demonstrate to be rather influential on Douyin's end in-feed ad revenue. By increasing both ad load and actual CPM by 50% from the currently assumed value, Douyin would reach an in-feed ad revenue of 42,574 million CNY. All else constant, this would give rise to a total revenue of 43,716 million CNY per year, roughly 6.25 billion USD[31]. This may seem to give reasonable space for its current high valuation - both of the key parameters have a proportional relationship with the in-feed ad revenue and both share the potential for future increase from its current value. However, as discussed, it is important to bear in mind that in-feed ad load shares an inverse proportional relationship with Douyin's customer experience and satisfaction – a higher ad load gives more advertisement thus more revenue but it also poses a risk of harming customer experience and satisfaction. promotion factor is also inversely related to Douyin's own bargaining power with advertisement providers – a higher promotion factor gives higher actual CPM, meaning that ad providers have to pay more to get their ads displayed on Douyin, thus raising the ad revenue but the increasing cost is likely to cause them to switch to other platforms, thus lowering Douyin's bargaining power.

Therefore, to depict Douyin's potential revenue growth with the influence of all parameters, we ran a simulation of all possible outcomes and plotted it in MATLAB. We set constraints on determinant variables based on prior discussions:

1. DAU is set be between 200 and 300 million, with 250 million as the most probable. As shown, it is unlikely that the average DAU would surpass 250 in the upcoming years, thus the distribution is positively skewed.
2. Daily active usage per user is set between 30 and 60 minutes. Probability of all values are distributed normally around 50 minutes.
3. Number of video clips per minute is set to be in range of 1 to 6, with 4 being the most likely.
4. In-feed ad load is set to be in range of 1.6% to 4.0% under normally distributed probability.
5. Promotion factor is set between 30 and 90 CNY with normal distribution around the current value, which is 60.

---

[31] In this thesis, the foreign exchange rate for USD/CNY is assumed to be fixed at 7(1 USD = 7 CNY, 1 CNY = 0.14 USD), long-term, unless otherwise stated.

We then ran the in-feed ad revenue projection under equation (4.2) and above constraints in MATLAB. The result is shown in Figure 21.
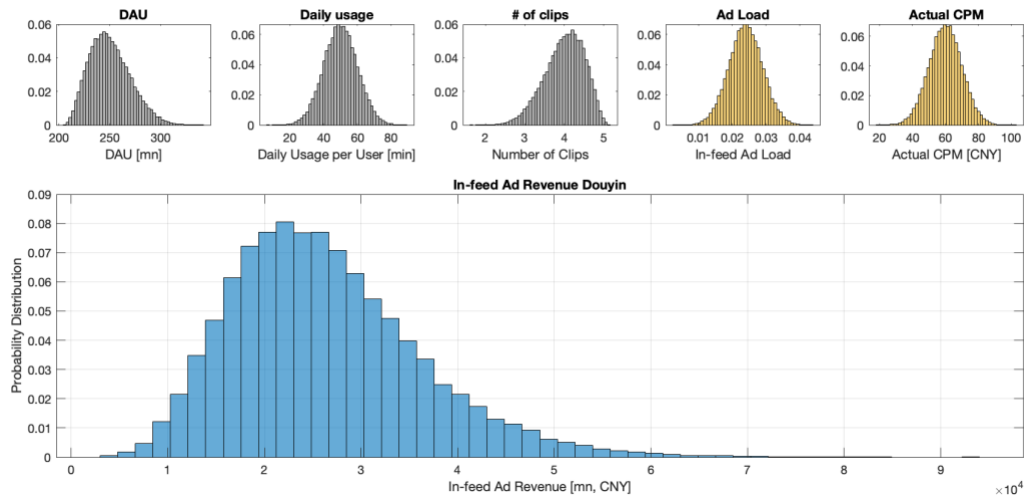

Figure 21: Projection of Douyin's in-feed ad revenue

From Figure 21 we can see that after taking into account all possible fluctuations of key variables, Douyin's in-feed ad revenue, the substantial component of its revenue, would be in range of 5 to 60 billion CNY. The most probable revenue projection lies between 18 and 30 billion CNY, which is around 2.5 to 4.5 billion USD.

4.2 Cost and Profit

As ByteDance is a private company, it is difficult to retrieve data on the company's cost or earnings. We believe that the cost structure of Douyin is rather complex. Following are some examples:

1. Cloud service
    a. Storage
    b. Content delivery network
    c. Distribution
2. Research and development (R&D) expenses

3. Sales and marketing
    a. Cost of acquiring customers
4. Operational expenses
    a. Personnel cost
    b. Rent
5. Overhead

It is reported that the company made a slim profit in 2017 (Dredge, 2019). In 2018, in order to increase the international user amount, the company spent heavily for oversea promotion. With limited success, the company made a 1.2 billion US dollars net loss (Zhang & Osawa, 2019). These numbers gave a profit margin of -16.9%

With the limited data and information on cost and earnings, it is very difficult to do an analysis. Thus, exclude their impact in the following analysis.

4.3 Valuation Analysis and Discussion

We examined four companies in similar industries to gain an understanding of its peers' performance – Weibo Corp., iQIYI Inc., Momo Inc., and Facebook Inc.. We chose the following companies on the following grounds:
1. They are publicly listed.
    All companies used for comparison here are public and are traded on NASDAQ Stock Market. The companies are all at a rather mature stage of development and growth. Their characteristics of being publicly traded also facilitates the retrieval of data.
2. They are in similar industries or have rather similar business model.
    Companies are in similar industries as Douyin and share rather similar business model with it. This similarity is to ensure that reasonable comparisons could be made as it leads to higher level of comparability.
3. They represent both international and local competitors.

The four companies chosen are present in either international or local (Chinese) market to provide a more holistic view.

Given the above criteria, we consider these four companies to be comparable to Douyin, and that the analysis of their valuation metrics should shed some light on a fair estimated value of Douyin.

The companies, their core business, and their business models are introduced briefly below.

Weibo Corp.

"Weibo" means microblog in Chinese and is a modern and popular way for people to create and share content online. Often compared with Twitter, Sina Weibo is a microblogging platform launched by Sina Corporation in August 2009 and operated by Weibo Corporation (later referred to as "Weibo"), a leading social network company in China (Koetse, 2015; Lei, Zhang, & Xu, 2013). By December 2018, Weibo has 462 million in MAU, with mobile MAU making up 93% of the total, and 200 million in DAU on average (Weibo Corporation, 2019).

Weibo enables companies and brands to promote their products and services to all users. It offers a great variety of marketing solutions and has become one of the most prominent platforms and influential medium for online advertisements. The company generates a substantial proportion of its revenue from advertising and marketing. In 2018, the advertising and marketing revenue reached 1.5 billion US dollars, 87.3% of the company's net revenue (Weibo Corporation, 2019).

iQIYI Inc.

Formerly known by Qiyi, iQIYI Inc. (later referred to as "iQIYI") is a leading online entertainment service provider in China (Baidu Inc., 2013). Known as a Chinese alternative to Netflix, iQIYI provides television services distributed by Internet and can also be used on mobile devices such as tablets and smartphones (Lotz, Lobato, & Thomas, 2018).

Launched in April 2010 by the leading Chinese search engine Baidu Inc., iQIYI has built a massive user base. It started as a video-on-demand company and employed a freemium business model. With

a rapidly growing user base, iQIYI developed paid premium membership, where members could skip advertisements and watch new releases earlier. It has now extended its means of monetarization beyond video distribution to live streaming, IP licensing, and online advertisements.

By December 2018, the number of total subscribers amounts to 87.4 million, in which 98.5% are paying premium subscribers. Note that users do not necessarily need to subscribe to watch videos – a lot of contents are available to the general audience at no cost. This could explain the vast difference between its MAU and number of subscribers. By January 2019, iQIYI reported MAU of 454.5 million and 424.1 million on mobile and PC terminal, respectively (Smith, 2019). From the company's 2018 annual report we can see that the company's revenue comes from two areas predominantly – paid premium subscriptions and online advertisements. In 2018, these two services reported revenues of 1.5 billion and 1.4 billion US dollars, respectively – accounting for 80.6% of the company's total revenue, which is 3.6 billion US dollars. However, iQIYI has been putting increasing amount of resources into content production and acquisition. In 2018, the cost of contents amounted to 3.1 billion US dollars, a 67% increase from previous year, accounting for 79.5% of the company's total cost. It is worth mentioning that with a cost of revenue of 3.9 billion US dollars, iQIYI is yet to be profitable (IQIYI Inc., 2019).

With a market penetration rate of 43.6% by June 2018, iQIYI has the same biggest market share in the online video industry in China, closely following Tencent video (Long, 2018).

Momo Inc.

Momo Inc. (later referred to as "Momo") was funded in Beijing in 2011. It is a leading social media and entertainment platform in China. Momo operates under the idea of connecting people through the precise geolocation-based services and interactive live video features provided by the platform (Sebastian, 2019).

In May 2018, Momo acquired Tantan, a leading social and dating app in China that is designed to help its users find, meet and establish relationships with people (Lunden, 2018).

In December 2018, Momo reported a MAU of 113.3 million, a 14.3% increase from the same period in 2017. With a net revenue of nearly 2 billion US dollars and a net income of 409.5 million US dollars, Momo operates under a profit margin of 21.0% in 2018 (Momo Inc., 2019).

Facebook Inc.

Facebook Inc. (later referred to as "Facebook") is a leading American social media company providing various kinds of online social networking products and services to users around the world. It enables users to build own profiles, discover and connect to others, and message instantly under WiFi and Internet. The massive pool of private information on users allows Facebook to target its users with customized and individualized advertisements. A substantial proportion of Facebook's revenue streams from advertisements (Cauwels & Sornette, 2012). In 2018, 98.5% of Facebook's total revenue was generated from its advertising services (Facebook Inc., 2019).

Founded by Mark Zuckerberg in February 2004, Facebook is now one of the biggest online social networking platforms in the world. With various products and services in the offering, such as WhatsApp, Instagram, Oculus, and Facebook Messenger, the company reported 1.5 billion in DAU and 2.3 billion in MAU for December 2018 (Facebook Inc., 2019). With a DAU/MAU of 65.2%, Facebook experiences and stands a high level of user engagement and stickiness – on average, users return to the site 20 days out of a month (Cuffe et al., 2018).

The key performance data of these four comparable companies are summarized and shown in Table 8, along with the valuation metrics.

Table 8: Key metrics and multiples of companies, FY18[32]

Company	S	MC	MAU	DAU	DAU	ARPU	P/S	MC/	MC/

---

[32] All data are as of December 2018, unless otherwise stated. Market capitalization of the listed companies Weibo Corp., iQIYI Inc., Momo Inc., and Facebook Inc. was taken as of March 6th, March 15th, March 12th, and January 30th, 2019, respectively. These dates were determined based on the dates on which corresponding companies released their annual report, and were used to take into account

	[mn, $]	[mn, $]	[mn]	[mn]	/MAU	[$]		MAU	DAU
	Sales revenue	Market capitaliza-tion	Monthly active users	Daily active users	User stickiness	Average revenue per user	Sales multiple	Market cap-to-MAU ratio	Market cap-to-DAU ratio
	A	B	C	D	D/C	E	B/A	B/C	B/D
Facebook	55,838	429,300	2,320	1,523	66%	24.96	7.7	185.0	281.9
Momo	1,950	7,540	113	n/a	n/a	18.88	3.9	66.5	n/a
Weibo	1,719	14,990	462	200	43%	4.00	8.7	32.4	75.0
iQIYI	3,635	19,640	454	135	30%	8.00	5.4	43.2	145.1
Douyin	2,700	n/a	426	207	49%	9.28[33]	n/a	n/a	n/a
ByteDance	7,000	75,000	598	250	42%	20.06	10.7	125.4	300.0

From Table 8, we can see Douyin contributes to approximately 40% of ByteDance's annual sales revenue. ByteDance's sales multiple, being 10.7, is higher than all four comparable companies. However, if we look more closely on user-related metrics, we can see that it has a fairly high ARPU. If we compare it with the other companies, we can see that Douyin's ARPU is significantly higher than Weibo and iQIYI, the comparable companies in China that shares similar level of MAU with Douyin, and closely follow Facebook. However, Facebook has a much higher user stickiness, MAU and sales revenue. Due to its global presence, its ARPU can be viewed separately when segmenting by geography – in 2018, its annual ARPU sported 111.97 USD in US and Canada but only 10.71 USD in Asia Pacific (Facebook Inc., 2019). As Douyin operates mainly in China and other Asian countries such as India, Japan, and Indonesia – we would conclude that it is only fair to compare its ARPU to Facebook's Asian segment. Given that Douyin's current ARPU is above-mean and higher than the comparables, we think that it is highly likely to decrease in the future.

We then estimated the value of Douyin and ByteDance based on different multiples of the four companies – results are summarized and shown in Table 9 below.

Table 9: Estimated value of Douyin and ByteDance based on different multiples of the four companies

Comparable	Douyin			ByteDance		
	P/S	MC/MAU	MC/DAU	P/S	MC/MAU	MC/DAU
Facebook	20,758	78,828	58,349	53,818	110,656	70,469

the impact of the reports on share value. Source: Weibo Corp., iQIYI Inc., Momo Inc., Facebook Inc., *2018 Annual Report*, Yahoo Finance, YCharts, ByteDance

[33] Douyin's ARPU was obtained by dividing its annual revenue by its yearly average MAU in 2018.

Momo	10,439	28,350	n/a	27,064	39,796	n/a
Weibo	23,551	13,822	15,515	61,058	19,403	18,738
iQIYI	14,590	18,413	30,026	37,826	25,847	36,263

The majority of Internet companies experience fast growth in sales revenue but face negative net income – their business model are yet to be proven profitable (Demers & Lev, 2000). P/E ratio is thus a not good measure here for our comparison. As Internet companies generate substantial proportion of their revenue from advertising services, in many cases, web traffic and web usage plays an important role in determining the company's revenue (Keating, Lys, & Magee, 2003; Trueman, Wong, & Zhang, 2001). Their relative importance and high explanatory power over Internet companies' estimated revenue, and subsequently value, justify the choice of using MAU as an important factor in the analysis.

Though not always cash flow positive, the chosen companies do experience a stable revenue growth. Given the characteristics of Internet companies, we chose to use P/S here as the metric for comparison. We can see that the value of Douyin estimated under the CCA method has a lower and higher bound of 10.39 billion and 26.98 billion US dollars, respectively. This makes up approximately 14% to 36% of ByteDance's current valuation, 75 billion US dollars. While Douyin contributes to almost 40% of the company's total revenue in 2018, we would suggest that Douyin's sales multiple is rather at the higher end among the that of the comparable companies.

Looking again at Figure 21, we observe that there is still a lot of space for Douyin's revenue to grow in the upcoming years – it is highly probable that Douyin could gain up to 4.5 billion USD. This would support a valuation of Douyin at 17 billion USD in the case of low sales multiple like Momo and 45 billion USD in case of a sales multiple as high as Weibo's.

5 Conclusion

Overlooking the macro developments and trends in the mobile Internet market and short video industry, as well as unique characteristics of Internet companies that set them apart from traditional firms, we discussed existing approaches on company valuation and conclude that given the limited financial and operating data available to public, it is most suitable to look at Douyin under a relative valuation approach.

The revenue model of Douyin was first reviewed and discussed, the potential fluctuations of its key revenue drivers were then examined one by one to derive the future revenue projection. We adopted the methodology proposed by Cauwels and Sornette and predicted Douyin's future user growth. We looked into the potential user population under three different growth scenarios – base, high, and extreme growth, and estimated the value of Douyin accordingly. Four companies in similar industry were selected to act as comparables, their financial multiples were calculated and used as a base when valuing Douyin.

In 2018, ByteDance reached total revenue of 50 billion CNY (7.1 billion USD)[34], the lower end of its target. Together with its most recent valuation at 75 billion USD, it gives the company a sales multiple of 10.56[35]. This number seems to be at a higher end of the industry standard. From Table 8 we observe that the P/S multiples of the four comparable companies are in a range of 3.5 to 10. Comparing ARPU across the companies, we also see that Douyin's ARPU is higher than Weibo and iQIYI in the same market, as well as Facebook's Asia Pacific segment. We therefore view it as highly likely to decrease and revert to industry mean in the future.

---

[34] In this thesis, the foreign exchange rate for USD/CNY is assumed to be fixed at 7 (1 USD = 7 CNY, 1 CNY = 0.14 USD), long-term, unless otherwise stated.

[35] P/S of ByteDance was calculated by dividing its market cap (most recent value) by its sales from the most recent financial year 2018. 75 bn USD / 7.1 bn USD = 10.56.

To support this valuation, Douyin would need to have a more expanded user base, reaching a 700 million MAU in the extreme growth scenario. However, we believe that Douyin is coming to an end with its rapid growth phase and the user growth is expected to slow down or even stop. Its current user population, 500 million MAU, already reached the maximum carrying capacity under the high growth scenario. Douyin makes up approximately 40% of ByteDance's revenue, if the other products keep growing at the current pace in the future, the company's current valuation at 75 billion USD is believed to be too high.

However, that the estimated value might not be under the highest accurate as the business models of the comparable companies are not exactly the same as Douyin. For instance, Weibo and iQIYI employs premium accounts which contribute to the company's revenue to certain extent. However, the CCA method gives us a proxy on Douyin's current value and help to further analyze that of ByteDance.

References

Baidu Inc. (2013). Baidu Acquires Online Video Business of PPS for US $370 Million to Create China's Largest Online Video Platform. Retrived from https://www.prnewswire.com/news-releases/baidu-acquires-online-video-business-of-pps-for-us-370-million-to-create-chinas-largest-online-video-platform-206374511.html on April 13th, 2019

Beqiraj, E., & Davis, J. (2016). Dispute perspectives: Discounting DCF ? Retrieved from https://www.pwc.co.uk/tax/assets/dispute-perspectives-discounting-dcf.pdf on April 12th, 2019

Borak, M. (2019). I wasted a week staring at 19 short video apps from China. Retrieved from https://www.abacusnews.com/digital-life/i-wasted-week-staring-19-short-video-apps-china/article/3000365 on May 10th, 2019

Bozovic, D. (2017). Unicorns Analysis: An Estimation of Spotify's and Snapchat's Valuation. Master thesis at ETH Zurich. Retrieved from https://www.ethz.ch/content/dam/ethz/special-interest/mtec/chair-of-entrepreneurial-risks-dam/documents/dissertation/master%20thesis/master_dimitribozovic_Final.pdf on May 12th, 2019

Byford, S. (2018). How China's ByteDance became the world's most valuable startup. Retrieved from https://www.theverge.com/2018/11/30/18107732/ByteDance-valuation-tiktok-china-startup on May 5th, 2019

ByteDance. (2018). ByteDance: To build global platforms of creation and communication. Retrieved from https://drive.google.com/open?id=1eH6PExk12Pid2svO6WbngUmejo09s51z on March 23rd, 2019

Calipha, R., Tarba, S., & Brock, D. (2010). Mergers and acquisitions: A review of phases, motives, and success factors. In Cary L. Cooper, Sydney Finkelstein (Eds.), *Advances in Mergers and Acquisitions* (pp. 1 -24). Bradford, Emerald Group Publishing Limited.

Campbell, C., Mattison Thompson, F., Grimm, P. E., & Robson, K. (2017). Understanding Why Consumers Don't Skip Pre-Roll Video Ads, *Journal of Advertising*, 46 (3), 411-423.

Capital City Training & Consulting. (2011). Comparable company analysis. *Valuation* (pp. 57-81). London, Capital City Training Ltd.

Cauwels, P., & Sornette, D. (2012) Quis pendit ipsa pretia: facebook valuation and diagnostic of a bubble based on nonlinear demographic dynamics. *Journal of Portfolio Management,* 38(2), 56-66.

Chen, L. Y., & Wang, S. (2019). ByteDance Hits Lower-End of Sales Goal Amid Slowdown. Retrieved from https://www.bloomberg.com/news/articles/2019-01-15/ByteDance-is-said-to-hit-lower-end-of-sales-goal-amid-slowdown on April 25th, 2019

Chen, T. (2017). Toutiao: a rising $30 billion USD Chinese tech giant. Retrieved from https://walkthechat.com/toutiao-rising-chinese-tech-giant/ on March 20th, 2019

Chiang, H. Sen, & Hsiao, K. L. (2015). YouTube stickiness: the needs, personal, and environmental perspective. *Internet Research*, 25(1), 85-106.

Cuffe, J. C., Narayan, A., Narayanan, C., Wadhar, H., & Wang, J. (2018). Engagement Drives Stickiness Drives Retention Drives Growth. Retrieved from https://medium.com/swlh/engagement-drives-stickiness-drives-retention-drives-growth-3a6ac53a7a00 on April 10th, 2019

Damodaran, A. (2019a). Valuation : Lecture Note Packet 1 Intrinsic Valuation. Retrieved from http://people.stern.nyu.edu/adamodar/pdfiles/eqnotes/packet1pg2.pdf on April 5th, 2019

Damodaran, A. (2019b). Valuation Packet 2: Relative Valutation, Asset-based Valuation, and Private Company Valuation. Retrieved on http://people.stern.nyu.edu/adamodar/pdfiles/eqnotes/packet2.pdf on April 5th, 2019

Dannible & McKee LLP. (2019). 3 Approaches to Valuing a Business. Retrieved from https://www.dmcpas.com/article/3-approaches-to-valuing-a-business/ on April, 2019

Demers, E. A., & Lev, B. (2000). A Rude Awakening: Internet Shakeout in 2000. EFA 0660; EFMA 2000 Athens Meetings; Simon Business School Working Paper No. FR 00-13.

Dredge, S. (2019). Report: TikTok's parent company lost $1.2bn in 2018. Retrieved from https://musically.com/2019/03/07/report-tiktoks-parent-company-lost-1-2bn-in-2018/ on May 17th, 2019

Essence Securities. (2018). Analysis of the use of valuation methods in Internet companies. Retrieved from http://pfile.essence.com.cn/data/00/1A/CgcKWFrOD5SADYzaABwQxgcxaE8723.pdf on May 5th, 2019

Facebook Inc. (2019). 2018 Annual Report. Retrieved from https://s21.q4cdn.com/399680738/files/doc_financials/2018/Q4/Q4-2018-Earnings-Release.pdf on May 20th, 2019

Folger, J. (2018). DCF Analysis: Coming Up with a Fair Value. Retrieved from
https://www.investopedia.com/university/dcf/dcf4.asp on March 4th, 2019

Foye, J. (2008). Valuing Cyclical Companies by Using the Price/Sales Ratio. Retrieved from
http://www.marketoracle.co.uk/Article6552.html on March 10th, 2019

Godek, P., McCann, C., Simundza, D., & Taveras, C. (2011). Rethinking the Comparable
Companies Valuation Method. Retrieved from
https://www.slcg.com/pdf/workingpapers/CCV paper.pdf on April 1st, 2019

Hargrave, M. (2019). Price-to-Sales Ratio (P/S Ratio). Retrieved from
https://www.investopedia.com/terms/p/price-to-salesratio.asp on April 3rd, 2019

Hariharan, A. (2017). The Hidden Forces Behind Toutiao: China's Content King. Retrieved from
https://blog.ycombinator.com/the-hidden-forces-behind-toutiao-chinas-content-king/ on
March 20th, 2019

Holterman, W., & van de Pol, M. (2016). Mergers & Acquisitions, PwC report. Retrieved from
https://www.pwc.nl/nl/assets/documents/pwc-mergers-acquisitions.pdf on April 4th, 2019

Huang, Z. (2018). Tencent-backed short video app Kuaishou launches mini game similar to
WeChat's offering. Retrieved from https://www.scmp.com/tech/apps-
social/article/2178668/tencent-backed-short-video-app-kuaishou-launches-mini-game-similar
on March 5th, 2019

Iqbal, M. (2019). TikTok Revenue and Usage Statistics (2019). Retrieved from
http://www.businessofapps.com/data/tik-tok-statistics/ on March 28th,2019

IQIYI Inc. (2019). 2018 Annual Report. Retrieved from https://ir.iqiyi.com/static-files/83481f9b-
238f-4841-9591-c0f9c817c7dc on March 15th, 2019

Jennergren, L. P. (2008). Continuing value in firm valuation by the discounted cash flow model.
European Journal of Operational Research, 185(3), 1548-1563.

Jing, M. (2018). This migrant worker lost his 56-year-old mentally ill sibling during Lunar New Year
travel crush. Toutiao helped find him. Retrieved from https://www.scmp.com/tech/social-
gadgets/article/2133363/migrant-worker-lost-his-56-year-old-mentally-ill-sibling-during on
April 4th, 2019

Keating, E. K., Lys, T. Z., & Magee, R. P. (2003). Internet downturn: Finding valuation factors in
Spring 2000. *Journal of Accounting and Economics*, 34(1-3), 189-236.

Kenton, W. (2019). Enterprise Value-to-Sales – EV/Sales Definition. Retrieved from
https://www.investopedia.com/terms/e/enterprisevaluesales.asp on May 17th, 2019

Kim, H. W., Chan, H. C., & Gupta, S. (2007). Value-based Adoption of Mobile Internet: An empirical investigation. *Decision Support Systems*, 43(1), 111-126.

Kirk, W. C., & Wishing, K. J. (2018). Fundamentals of the Asset-Based Business Valuation Approach. *Insights*, (114), 3–14.

Klobucnik, J., & Sievers, S. (2013). Valuing high technology growth firms. *Journal of Business Economics*, 83(9), 947-984.

Knight, W. (2018). The Insanely Popular Chinese News App That You've Never Heard Of. Retrieved from https://www.technologyreview.com/s/603351/the-insanely-popular-chinese-news-app-that-youve-never-heard-of/ on March 3rd, 2019

Koetse, M. (2015). A Short Introduction to Sina Weibo: Background and Status Quo. Retrieved April 21, 2019, from https://www.whatsonweibo.com/sinaweibo/ on April 29th, 2019

Lam, T., & Li, C. (2018). Short video platform – Douyin. *Fung Business Intelligence - Uncovering the Emerging Players in China's e-Commerce*, (1), 1-10.

Lei, K., Zhang, K., & Xu, K. (2013). Understanding Sina Weibo online social network: A community approach. *GLOBECOM - IEEE Global Telecommunications Conference*, 3114-3119.

Levy, A. (2017). The 4 Pillars of Facebook's Growing Ad Revenue. Retrieved from https://www.fool.com/investing/2017/05/09/the-4-pillars-of-facebooks-growing-ad-revenue.aspx on April 10th, 2019

Li, H., & Lo, H. Y. (2015). Do You Recognize Its Brand? The Effectiveness of Online In-Stream Video Advertisements. *Journal of Advertising*, 208-218.

Long, D. (2018). China's online video market hits 76% penetration, led by Tencent Video and iQiyi. Retrieved from https://www.thedrum.com/news/2018/09/24/china-s-online-video-market-hits-76-penetration-led-tencent-video-and-iqiyi on March 10th, 2019

Lotz, A. D., Lobato, R., & Thomas, J. (2018). Internet-Distributed Television Research: A Provocation. *Media Industries Journal*, 5(2), 35-47.

Luciano, R. (2003). EBITDA as an indicator of earnings quality. *Journal of Applied Science in Southern Africa*, (1), 29.

Lunden, I. (2018). Momo buys Tantan, China's Tinder, for over $600M as Chinese social networks consolidate. Retrieved from https://techcrunch.com/2018/02/23/momo-buys-tantan-chinas-tinder-for-600m-as-chinese-social-networks-consolidate/ on April 25th, 2019

Mauboussin, M. J. (2018). What Does an EV/EBITDA Multiple Mean? Retrieved from https://www.bluemountaincapital.com/wp-content/uploads/2015/03/What-Does-an-EV-

EBITDA-Multiple-Mean.pdf on March 10th, 2019

McClure, B. (2019). How to Use Price-To-Sales Ratios to Value Stocks. Retrieved from
https://www.investopedia.com/articles/fundamental/03/032603.asp on March 10th, 2019

McKnight, L. W., & Bailey, J. P. (1995). An Introduction to Internet Economics. *The Journal of Electronic Publishing*, 1 (1&2).

Meitner, M. (2006). Foundations of Comparable Company Valuation. *The Market Approach to Comparable Company Valuation* (pp. 7-45), s.l., Physica-Verlag Heidelberg.

Momo Inc. (2019). 2018 Annual Report. Retrieved March 18, 2019, from
http://ir.immomo.com/static-files/ab80b9fd-77f1-4186-a5ba-e151dcd2e6e0 on April 18th, 2019

Nogueira Reis, P. M., & Augusto, M. G. (2013). The Terminal Value (TV) Performing in Firm Valuation: The Gap of Literature and Research Agenda. *Journal of Modern Accounting and Auditing*, 9(12), 1622-1636.

Peterson, T. (2017). The most important thing to know about Facebook's ad load problem. Retrieved from https://marketingland.com/important-thing-know-facebooks-ad-load-problem-213826 on April 14th, 2019

QuestMobile. (2019). 2018 China Mobile Internet Report. Retrieved from
http://www.questmobile.com.cn/research/report-new/58 on April 10th, 2019

Ramli, D., Wang, S., & Chen, L. Y. (2018). ByteDance Is Said to Secure Funding at Record $75 Billion Value. Retrieved from https://www.bloomberg.com/news/articles/2018-10-26/ByteDance-is-said-to-secure-funding-at-record-75-billion-value on March 7th, 2019

Saari, S. R. (2012). How company is valued – an overview of valuation methods. *CPAs, Business & Financial Advisors*, 20.

Sebastian, J. (2019). Momo Inc (MOMO) Shares Bought by Eqis Capital Management Inc. Retrieved from https://www.fidaily.com/2019/04/23/momo-inc-momo-shares-bought-by-eqis-capital-management-inc.html on April 17th, 2019

Smith, C. (2019). 20 Interesting iQiyi Facts and Statistics. Retrieved from
https://expandedramblings.com/index.php/iqiyi-facts-statistics/ on April 17th, 2019

Smolentceva, N. (2019). TikTok: World's most successful video app faces security concerns. Retrieved from https://www.dw.com/en/tiktok-worlds-most-successful-video-app-faces-security-concerns/a-48063869 on April 5th, 2019

StatCounter. (n.d.). Mobile internet traffic as percentage of total web traffic in November 2018.

Retrieved March 6, 2019, from https://www-statista-com/statistics/306528/share-of-mobile-internet-traffic-in-global-regions/ on April 13th, 2019

Tang, S. (2019). Xigua Video, The Subsidiary Of ByteDance, Is Sued By Tencent. Retrieved from https://equalocean.com/communications/20190218-xigua-video-the-subsidiary-of-ByteDance-is-sued-by-tencent on April 4th, 2019

Tracy, J. H., & Tracy, T. C. (n.d.). Putting EBITDA in Perspective. Retrieved from http://csinvesting.org/wp-content/uploads/2015/02/Placing-EBITDA-into-Perspective.pdf on March 10th, 2019

Trueman, B., Wong, F. M. H., & Zhang, X.-J. (2001). Back to Basics : Forecasting the Revenues. *Review of Accounting Studies*, 6, 2-3.

Wagner, K. (2017). Facebook is putting ads everywhere in hopes of finding the next News Feed. Retrieved from https://www.recode.net/2017/7/15/15973750/facebook-ads-everywhere-instagram-messenger-whatsapp on April 21st, 2019

We Are Social, & DataReportal, & H. (n.d.). Global digital population as of January 2019 (in millions). Retrieved from https://www-statista-com/statistics/617136/digital-population-worldwide/ on March 6th, 2019

Weibo Corporation. (2019). 2018 Annual Report. Retrieved from http://ir.weibo.com/static-files/bef3ea16-ce26-41f9-9424-04a2371d1c92 on March 15th, 2019

Xu, T. (2019). Briefing: ByteDance reportedly aims for RMB 100 billion revenue in 2019. Retrieved from https://technode.com/2019/02/21/briefing-ByteDance-reportedly-aims-for-rmb-100-billion-revenue-in-2019/ on April 4th, 2019

Yang, Y. (2018). ByteDance to enter China's long-form streaming video market, challenging iQiyi, Tencent Video. Retrieved from https://www.scmp.com/tech/start-ups/article/2164304/ByteDance-enter-chinas-long-form-streaming-video-market-challenging on March 10th, 2019

Zhang, Y., & Osawa, J. (2019). China's ByteDance Plans Slack Rival Even as Losses Mount. Retrieved from https://www.theinformation.com/articles/chinas-ByteDance-plans-slack-rival-even-as-losses-mount? on April 17th, 2019

Appendix

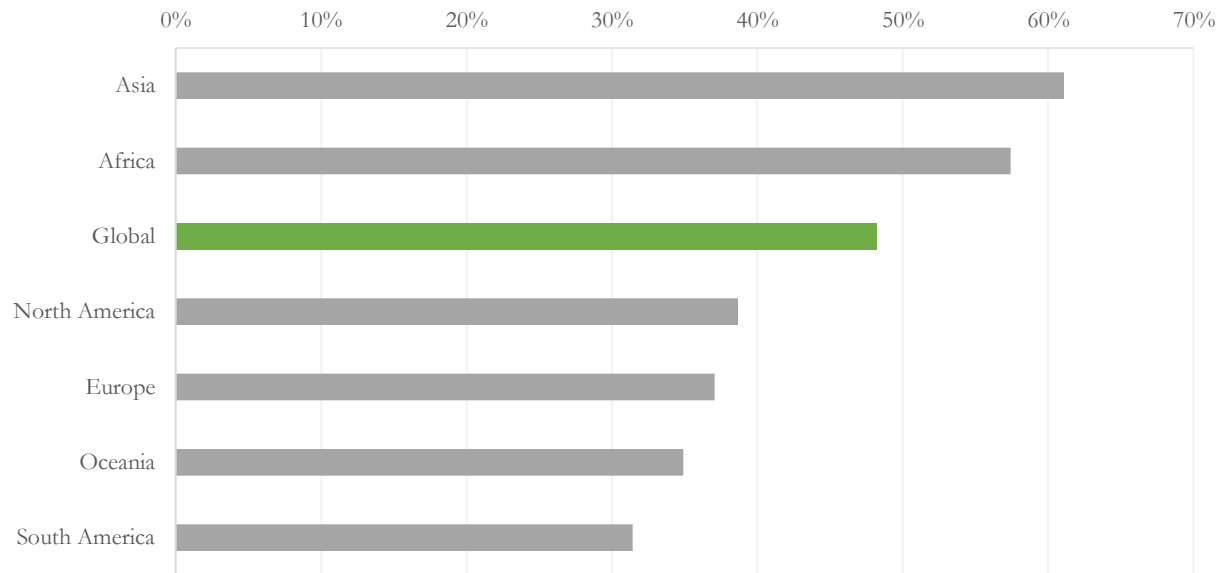# Appendix A Global share of mobile Internet traffic

Figure 22: Mobile internet traffic as percentage of total web traffic in November 2018, by region

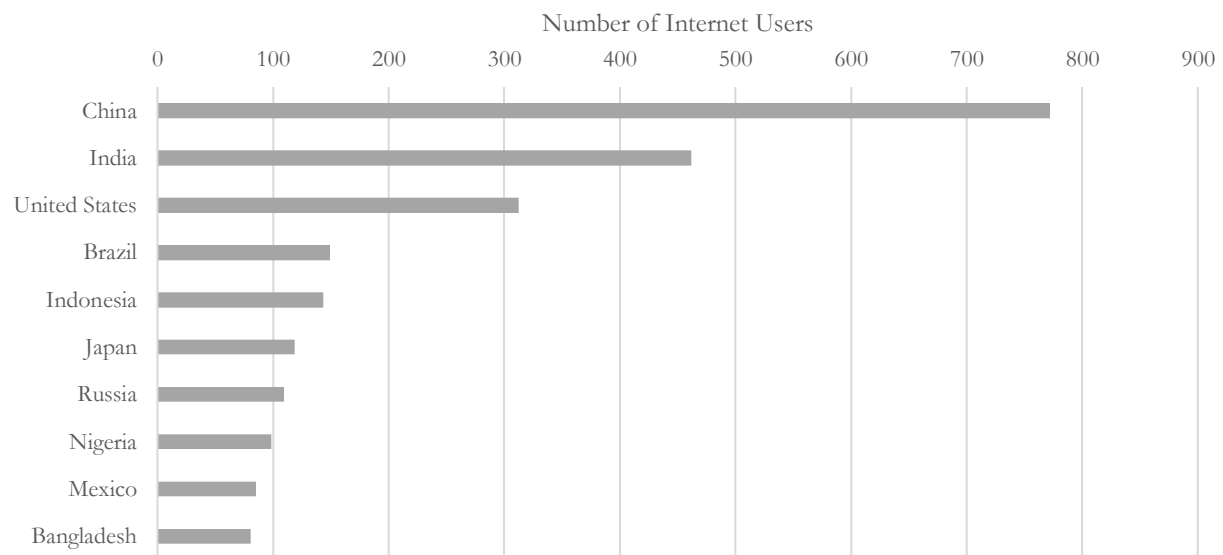# Appendix B Countries with the most Internet users

Figure 23: Countries with the highest number of internet users as of December 2017, in millions

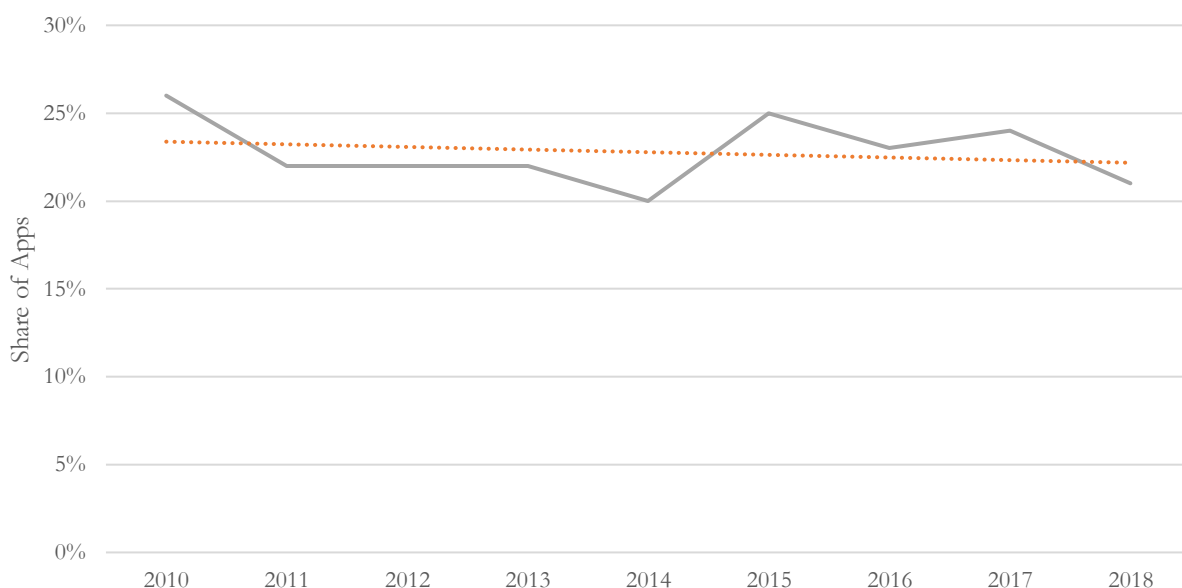# Appendix C Percentage of mobile apps that have been used only once

Figure 24: Percentage of Mobile Applications that Have Been Used Only Once, 2010-2018

Appendix D Official pricing of ads on Douyin app

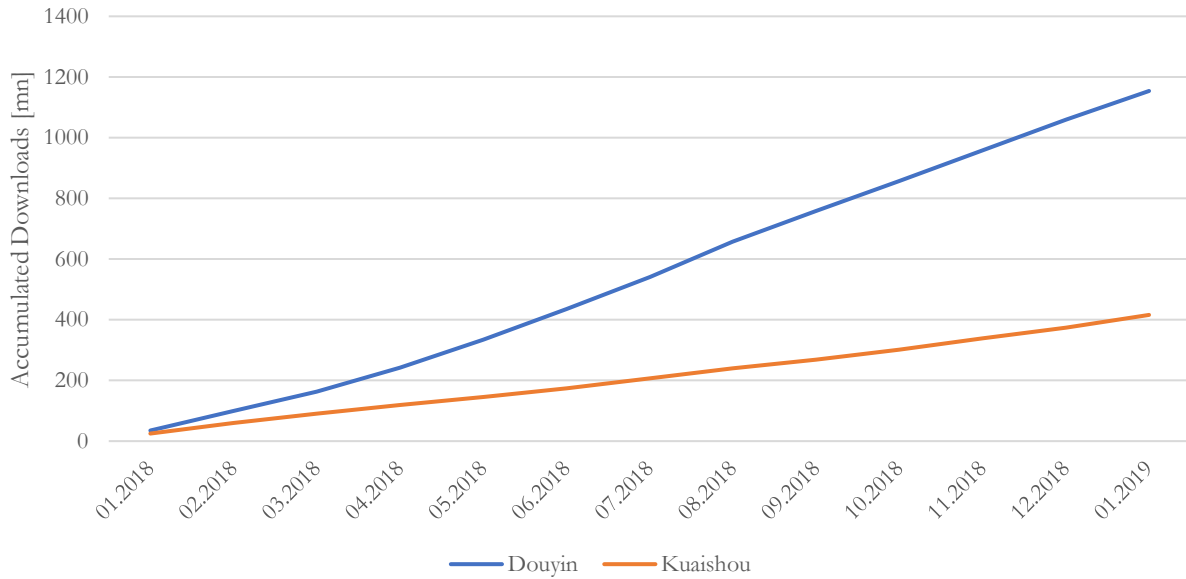# Appendix E Accumulated Downloads of Douyin & Kuaishou

Figure 25: Accumulated Downloads of Douyin and Kuaishou, 2018-2019

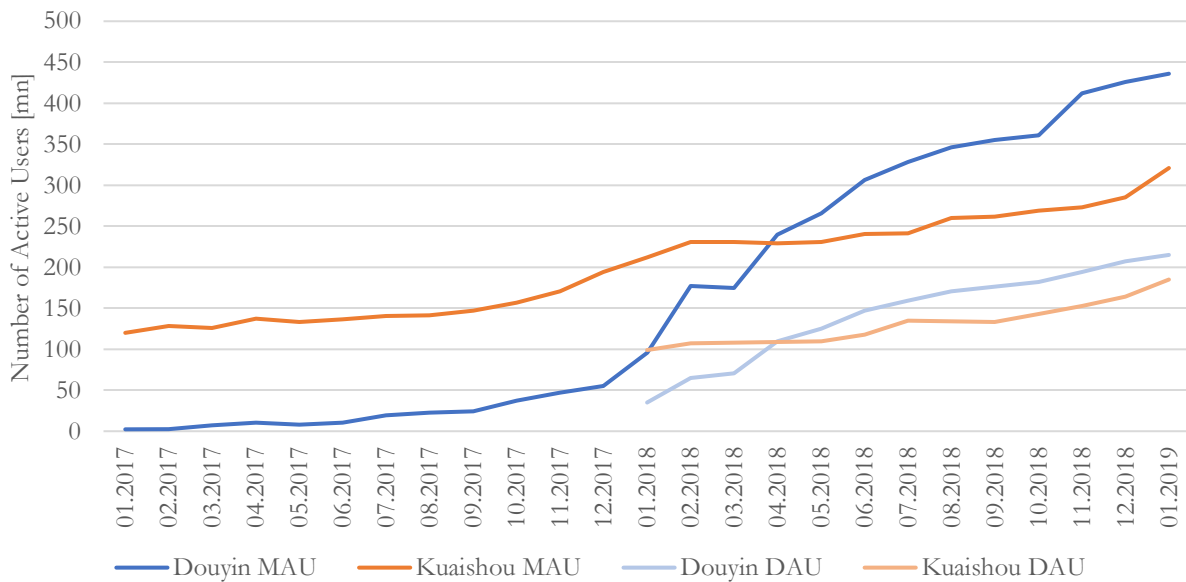# Appendix G User development of Douyin

Figure 26: MAU and DAU development of Douyin and Kuaishou, 2017-2019
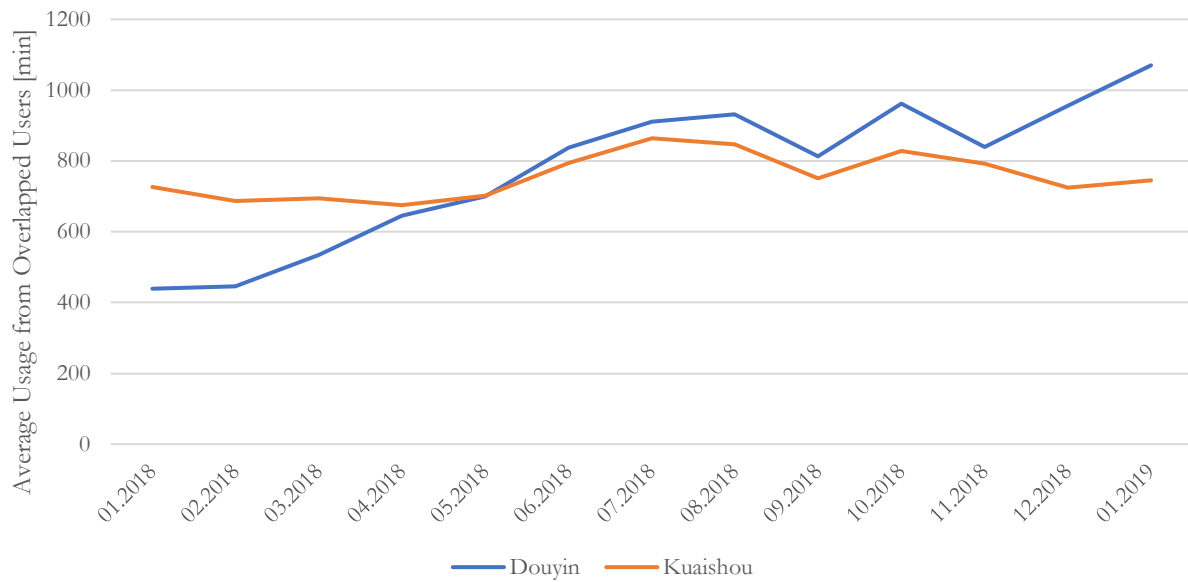
Appendix H Daily usage from overlapping users

Figure 27: Average usage per day from overlapping users of Douyin and Kuaishou