

# Impact of social media adoption on firm value: Evidence from China

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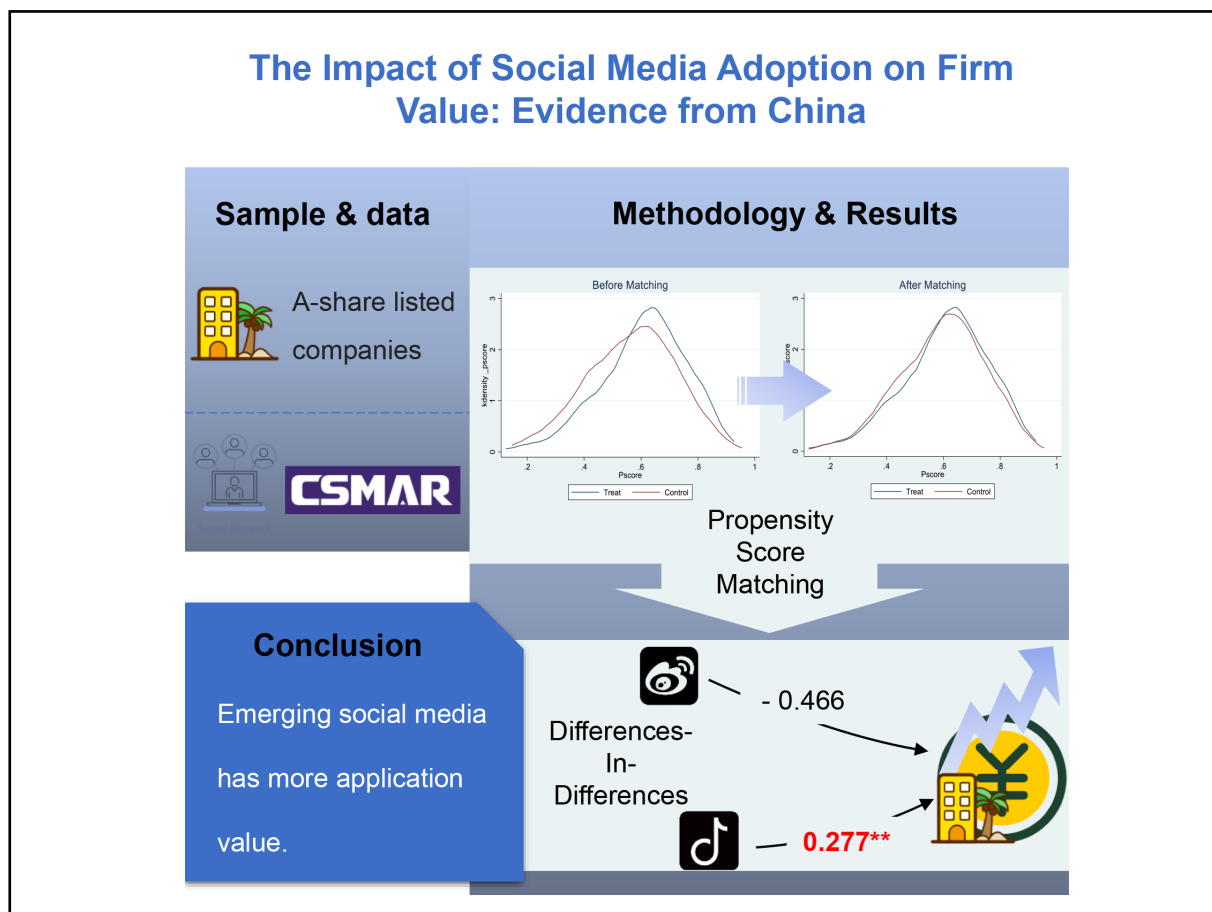
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## Graphical abstract



## Public summary

- Verifies the relationship between social media applications and firm value, in China.
- Utilizes measures of policy evaluation to reduce the endogeneity.
- Some empirical support for the positive impact of short video platforms on firm value, but not microblogs.
- More research is needed into relations between emerging social media application and firm value.

# Impact of social media adoption on firm value: Evidence from China

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**Abstract:** Social media has become an essential channel for increasing firm value. This study explores the impacts of social media operation (i.e., microblog and short video platforms) on firm value in the context of China. The research adopts the multi-stage propensity score matching (PSM) and differences-in-differences (DID) design, and the research results indicating that the operation of short video platforms for social media marketing can significantly increase firm value. However, the operation of microblogs for social media marketing insignificantly affects firm value. This means that the company's operation of emerging social media platforms is of positive significance to firm value. Moreover, the conclusions of this study will guide the company's social media operations.

**Keywords:** social media; firm value; multiphase PSM-DID

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## 1 Introduction

Social media has currently become a vital channel for enterprises to market and promote their brands and products<sup>[1-2]</sup>. The market faces a torrent of online communication spread via social media<sup>[3]</sup>. As indicated by *the Global Network Report of We Are Social*, social media has become an integral part of people's daily life globally, and there are 3.96 billion users of social media worldwide, which demonstrates that over half of the population uses social media in the world. Given that social media is recognized as a rapidly booming marketing platform worldwide<sup>[4]</sup>, plentiful firms have initiated their digital asset building<sup>[5]</sup>. A survey<sup>[6]</sup> shows that a great number of Fortune 500 companies have established their social media accounts (e.g., Facebook, Twitter, Google, Instagram, YouTube, Foursquare and Pinterest).

As social media being extensively applied, there is widespread concern about the value of social media to companies<sup>[5]</sup>. Existing studies found that the application of social media helps enterprises fulfill micro-level goals (e.g., employee collaboration and communication, product sales, inter-enterprise communication and supply chain management, novel product development, customer service and customer relationship management, creative generation, as well as innovation of enterprise operation efficiency)<sup>[7-10]</sup>. Moreover, several studies explored the macro value of social media to enterprises. For instance, numerous studies proved that the use of social media positively impacts on corporate financial performance<sup>[2,11-12]</sup>, and several studies demonstrated that the use of social media positively impacts on the non-financial performance of enterprises as well (e.g., improved customer relations, improved information accessibility and augmented brand visibility)<sup>[13-16]</sup>.

A survey of small and medium-sized enterprises reports that social media and improvement in enterprise performance are correlated<sup>[17]</sup>. However, while plentiful studies placed their focus on the value of social media, the benefits of adopting social media have been questioned for the listed companies<sup>[18-19]</sup>.

It is noteworthy that the existing studies have focused on Western social media but have not explored the effect of social media on firm value in China. Further, considering that the political, economic, social, and cultural backgrounds of Western countries such as the US and the UK differ from that of China<sup>[20-22]</sup>, the world's largest social media market<sup>[23]</sup>, China deserves to be studied separately. China prefers videos based on the type of online content. Differences in the user characteristics of China and the Western countries negatively impact the return on investment in social media marketing<sup>[24]</sup>. Considering that the rapid advance of China's short video platforms over the last years has boosted the rapid iteration of social media platforms and offered enterprises different social media scenarios, it is of theoretical significance to explore the value of different social platforms to enterprises. The emerging social media platform is characterized as short-form videos, rich content and novel formats<sup>[25]</sup>, arousing the attention of a large number of users. San and Meng suggested that the daily and monthly activities of Douyin have surpassed those of Sina microblog<sup>[26-27]</sup>, and the gap is gradually widening. In this study, social media is considered as a strategic resource for enterprises<sup>[28]</sup>, and the adoption of emerging social media is regarded as a dynamic capability to adapt to changes in the social media market. This study is a supplement to the social media capability in dynamic capability theory and provides a theoretical basis for enterprise decision-

making on expanding social media platform channels.

This study selects two popular social media platforms, Sina microblog and Douyin, as the primary research scenarios to explore the impact of social media platforms on firm value. The financial data of listed companies in the A-share market from June 2009 to September 2020 are collected, and this study considers the time when each A-share company opened social media accounts to establish a big dataset that spans multiple periods. In this dataset, the multi-phase propensity score matching (PSM) and differences-in-differences (DID) design methods are used to verify the relationship between firm value and the behavior of enterprises to operate social media accounts and share relevant information. By verifying the above relationship, this study has the following important contributions. ① In this study, empirical evidence is provided from China, an important emerging market. China's data is used to confirm that using Sina microblog cannot have a significant impact on firm value, and the empirical results are inconsistent with those of foreign studies. ② The social media research scenario is expanded. As confirmed by our empirical results, the adoption of short video platforms is positively correlated with firm value. ③ The range of the subjects analyzed is expanded. Existing studies focused on a single industry (e.g., restaurant and hotel computer hardware and software)<sup>[12,17,29–30]</sup>. This study separately and comprehensively confirms the correlation between the behavior of registering and posting social media and the firm value of listed companies in the catering and lodging industries. ④ A novel method is proposed to investigate social media. This study also presents the research method of multi-phase PSM-DID.

## 2 Literature review and hypothesis

### 2.1 Literature review

Social media has a significant impact on the increase of firm value<sup>[31]</sup>, as the economy becomes more knowledge-based. Academic research on the topic has been widely conducted with the increasing use of social media for commercial purposes<sup>[32]</sup>. The impact of social media tools on enterprise performance is an emerging research direction that has made significant progress in the past few years<sup>[33]</sup>. Whether social media is recognized as a technological phenomenon propelling communication and collaboration embedded in humans' lives<sup>[34–36]</sup>. The issue of whether social media impacts organizational performance is worth exploring, whereas there have been rare investigations previously<sup>[16]</sup>. According to the empirical evidence presented by existing studies, social media can improve financial performance<sup>[11–12]</sup>, improve non-financial performance (e.g., improved customer relations, improved information accessibility and augmented brand visibility)<sup>[13,14,16,36,37]</sup> and increase trading volume<sup>[38]</sup>. Firms adopt policies and plans to fulfill business goals in which insights gleaned from information exchange contribute to decision-making<sup>[39,40]</sup>. Social media platforms have been frequently exploited as strategic marketing tools and channels for the promotion of novel products (e.g., goods and services<sup>[41]</sup>) to improve customer relations<sup>[42]</sup>, understand their individual preferences more deeply<sup>[43]</sup> and build customer equity<sup>[44]</sup>. In addition, the platforms above offer stakeholders several benefits

and services (e.g., location-based recommendations<sup>[45]</sup>, user reviews<sup>[46]</sup> and development of personal and company brands), and thus may bring a greater incremental value.

However, the use of social media shows some defects. Companies cannot comprehensively control their communication on social media platforms<sup>[47]</sup>, thereby causing their losses. Companies can be heavily criticized on the platforms above, and their social media communications efforts can have unintended consequences<sup>[48]</sup>. According to the official report issued by Sina microblog, there are some problems in the operation of enterprise microblogs (e.g., uneven quality of microblog information, improper publishing frequency, and the lack of creative content). These problems do not affect on the deepening brand connotation and publicity, although they negatively affect users' browsing experience. Xu et al.<sup>[49]</sup> adopted methods (e.g., social network analysis) and, from the perspective of negative oral broadcasting of microblogs, highlighted from the perspective of negative oral broadcasting of microblog that once negative word-of mouth occurs, the rapidity and universality of microblog information transmission will significantly impact enterprises, and even the industry in which the company is located and other companies and institutions in the identical industry will be affected. For microblog comments, Zhang et al.<sup>[50]</sup> highlighted that negative microblog comments would reduce consumers' perceived economic value, thereby weakening consumers' purchase intention of products. Accordingly, as China has an emerging market at the forefront of internet technology and social media technology, whether the adoption of social media by Chinese companies can make a company more valuable should be tested.

### 2.2 Hypotheses development

Social media application is the way in which enterprises apply social media as an agent for internal information transmission and external environment to acquire information, as an attempt to achieve information disclosure, mutual communication, stakeholder interaction and competitor monitoring<sup>[51–53]</sup>. Sina microblog is found as the most popular social platform in China<sup>[2]</sup>. From Sina, as of September 2020, there have been 511 million monthly active users and 224 million daily active users. The platform allows people to share information and interact in real time. Numerous companies have opened corporate microblogs to share information and interact with customers to develop relationships<sup>[5]</sup>.

According to signal theory, due to the information asymmetry in the buying and selling market, enterprises with more product information will have a potential information advantage, while consumers will be at an information disadvantage; consumers should predict the details of products with the help of observable signals transmitted by enterprises<sup>[54]</sup>. For companies, Sina microblog has two types of value. First, Sina microblog is a marketing and brand-building channel, since it covers a huge user scale, i.e., a huge market of potential customers. By publishing posts, the company can reasonably and adequately draw upon microblog's advantages (e.g., large user stickiness and wide information dissemination) to increase the company's exposure<sup>[55]</sup>, achieve viral marketing<sup>[5]</sup>, increase the company's marketing revenue and enhance the

company's financial performance. Following the signal theory, companies can also build their brands by properly managing their social media image, thereby improving brand reputation, brand awareness and brand name<sup>[56–59]</sup>, increasing the company's intangible assets and enhancing the company's value. For instance, the company can selectively deliver information regarding its development potential to investors to attract investors' attention, increase its credit capital, shape its social image and gain a competitive advantage<sup>[60]</sup>. This competitive advantage includes higher brand value, better corporate governance structure, and higher investor recognition<sup>[60]</sup>.

Second, as a communication platform, Sina microblog is adopted to deepen the relationship with customers<sup>[5]</sup>, develop long-term relationships and reliable repeated business, forge a stable customer base, and improve customer loyalty, satisfaction and retention<sup>[24,57–63]</sup>, as an attempt to help save costs and increase sales revenue<sup>[5,18,59,64]</sup>. Accordingly, the company's financial and non-financial performance can be improved. Users can understand the company's products and services through the Sina microblog. Following the signal theory, companies also disclose information via microblogs to enhance their information transparency<sup>[5]</sup>, mitigate information asymmetry, reduce the search cost for investors and deepen the relationship between listed companies and investors. On that basis, the public, investors and regulatory authorities can gain more comprehensive insights into the actual operating conditions of the company. Due to the extensive disclosure of information on social media, the company operators can be more committed to the company's operation, improve the company's performance<sup>[60]</sup>, as well as increase firm value. It is noteworthy that social media is advancing to the primary source of information for most individual and institutional investors during investment decision-making<sup>[65–67]</sup>. Chung et al.<sup>[67]</sup> highlighted that nearly 80% of institutional investors employ social media as a part of their everyday work process. Most state that the information acquired via social media directly impacts investment advice or decisions. In addition, as indicated by Da et al.<sup>[68]</sup>, Yu et al.<sup>[69]</sup> and Siamagka<sup>[36]</sup>, companies employ the microblog as a bridge to communicate with customers, shareholders and civil society. Research shows that actively managing customer relationships positively impacts a company's stock prices, which can increase firm value. Thus, we propose the following hypothesis.

**Hypothesis 2.1.** The presence of the microblog account is positively associated with firm value.

Short videos have led the trend of the new media era and become a trend for their simple production, vivid and interesting content, visual forms of expression and diversified mobile usage scenarios<sup>[70]</sup> in the new media era. They attract a large number of users and make companies pay attention to and invest in the operation of short videos. In addition, a considerable number of short video users spend much time on short videos on a day-to-day basis form a survey. They browse short videos in fragmented time and engage in social interaction (e.g., thumb up, forwarding, commenting and sharing). It will bring huge flow value to enterprise marketing<sup>[71]</sup>, thereby expanding the market coverage of marketing<sup>[72]</sup> and increasing marketing income.

Moreover, it can increase the page views of the content

sharply, elevate the exposure rate of the product or brand<sup>[72]</sup>, make the short video have the ability of viral transmission, improve the performance of the company and increase firm value. Short videos are free from complicated plots and lengthy preparations. The information is straight to the point, which is characterized by distinct viewpoints and concentrated content. It is capable of attracting people's attention more easily and making the audience have emotional resonance, and easy to accept and understand<sup>[73]</sup>, which will help consumers gain a more comprehensive insight into the company's products and services<sup>[71]</sup>, deliver brand value<sup>[74–77]</sup>, attract the buying attention of its consumers<sup>[78–80]</sup>, increase the company's business sales and enhance the company's value. In addition, it has the function of live broadcasting with goods in short videos. In the marketing process, consumers ask questions by complying with video content and get immediate feedback, which enables instant interaction and communication between marketers and consumers, thereby facilitating consumer management<sup>[81,82]</sup>, narrowing the distance between brand owners and consumers, building customer trust and cultivating customer loyalty. On that basis, firm value can be improved.

According to the dynamic capability theory, the market environment is dynamic, and enterprises should adjust themselves to the environment quickly by integrating and reconstructing internal and external resources<sup>[83]</sup>. Existing researches indicated that companies exhibiting a stronger ability to identify and adapt to varying conditions are more likely to be rewarded<sup>[84]</sup>. Companies should be prepared for constant market changes by exploiting social media platforms<sup>[83]</sup>. China's short video social media has been leaping forward. According to researches from San and Meng, the daily and monthly activities of Douyin have surpassed those of Sina, and the gap is gradually widening<sup>[26–27]</sup>. Complying with dynamic capabilities theory, companies can increase their value by keeping abreast with the times, i.e., using new social media. Accordingly, we propose the following hypothesis.

**Hypothesis 2.2a.** Adopting the short video platform can improve firm value.

**Hypothesis 2.2b.** Adopting the short video platform can improve firm value more than using microblog.

## 3 Data and methodology

### 3.1 Data sample and sources

This research examines the social media usage of firms from diverse industries, and the samples are from A-share listed companies in the Catering, accommodation, wine and beverage and refined tea manufacturing. It consists of 61 stocks that are selected from the China Securities Regulatory Commission (CSRC) industry classification for consumer-related stocks. We started from manually collecting the Sina microblog pages of related companies, where every page is released in September, 2020. Next, to collect all the information publicly, we used a network capture program that can be web pages and collect information. The starting date is September 30, 2020 in the official Sina microblog page of the companies. Because this is a large number of companies, we performed network grab plan to collect Sina microblog user be-



havior data since then. At the same time, in order to ensure the authoritativeness and persuadability of the manually collected information, in terms of the collecting of microblog data, users of the microblog with the name of the listed company are selected<sup>[85]</sup>. Data on companies' adoptions of short video platform are collected from the social media application by hand. The financial data are derived from the annual report of listed companies and the financial analysis from the tool of China Stock Market Accounting Research Database (CSMAR), all of which incorporate a wide range of financial data such as equities, equity indices, bonds, bond indices, and other financial instruments traded in Chinese markets. In our study, Stata 16.0 was utilized to analyze and process the data. Considering the launch date of Sina microblog in 2009 and the availability of financial data, the time interval of this study is defined from September 2009 to July 2020. We chose the quarterly interval because it is the smallest interval available from firms' financial statements<sup>[2]</sup>.

### 3.2 Variables and measures

Other than the independent variables, we selected some control variables based on prior studies, which are variables that are likely to influence firm value. The collected variables were: standard industry classification code, total assets, market value, long-term liability ratio, total asset return rate, total asset growth rate, and total asset turnover rate. The measurement of dependent, independent and control variables are explained in Table 1 explains the measurement of the dependent, independent, and control variables

#### 3.2.1 Explained variable

The purpose of this paper is to investigate the influence of company's social media on corporate value. In order to measure the factor of social media, the dummy variable "did" is set<sup>[83]</sup>.

The "did" refers to whether the company adopts and operates social media or not. The value of 1 indicates that the company's social media accounts are in operation, and the value of 0 indicates that the company's social media accounts are not active or not in operation at all. For each company that

has opened the official social media, further confirmation of social media account is required, because this article will the "did" assignment 1 to study enterprise by active social media accounts, the information of which has influence on the value of the company. As a result, for the social media without updating information content of the enterprise for nearly 1 year, the assignment is of 0 as the social media account is not active.

#### 3.2.2 Control variables

The methods for measuring enterprise value include financial and market indices. Considering that the financial index of an enterprise may have a strong correlation<sup>[86]</sup>. Su et al.<sup>[86]</sup> found that the ability to obtain cash has a significant correlation with long-term solvency by principal component analysis. Tobin's  $Q$  index has become a more accurate choice for the measurement of enterprise value<sup>[85]</sup>. Formula (1) shows the calculation method of Tobin's  $Q$  value in this study. The required data comes from CSMAR database, and abnormal data will be eliminated during calculation.

$$\text{Tobin's } Q = \frac{\text{market value}}{\text{replacement capital}} = \frac{(\text{number of market shares outstanding} + \text{number of non-outstanding shares net assets per share} + \text{book value of liabilities})}{\text{total book value of assets}} \quad (1)$$

#### 3.2.3 Control variables

Many factors influence volatility performance. Based on the references, the author has concluded the following important control variables in this study: Total return on assets(ROA), company growth index(Gra), long-term asset-liability ratio index(lev), total asset(asset), market value(MV), virtual variable (treat & did), among others.

Net return on assets(ROA) is an indicator of corporate profitability. The higher the value, the stronger the company's profitability and the more sufficient and stable its capital flow. Its continuous operational ability is stronger, and it is less likely to face a threat and challenge.

Table 1. Variable interpretation.

|                           | Variable name | Full name                                                                    | Paraphrase                                                                                                                                                                                                                   | Source                                                                |
|---------------------------|---------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| Main explanatory variable | did           | Presence of Sina microblog account                                           | Dichotomous variable that takes a value of 1 if firm has an account and some contents to be released in 2020, otherwise 0                                                                                                    | crawls data collects data manually CSMAR and the financial statements |
|                           |               | Presence of Douyin account                                                   |                                                                                                                                                                                                                              |                                                                       |
| Explained variable        | tobin_q       | Firm value (Tobin's $Q$ )                                                    | Market value of equity plus book value of debt divided by book value of total assets.                                                                                                                                        | CSMAR                                                                 |
|                           | lev_1         | Long-term gearing ratio                                                      | The proportion of non-current liabilities in long-term capital, which represents the company's long-term capital debt capacity                                                                                               |                                                                       |
|                           | ROA           | Rate of return on total assets(also known as return on total assets)         | It is an index that reflects the effect of comprehensive utilization of enterprise assets, and plays an important role in measuring the profits made by enterprises using the total amount of creditors' and owners' equity. |                                                                       |
| Control variable          | Gra           | Growth rate of total assets(Also known as the rate of total asset expansion) | It is the major index to analyze the capital accumulation ability and development ability of enterprises in the current year.                                                                                                | CSMAR                                                                 |
|                           | TAT           | Capital intensity                                                            | Ending balance of operating income/total assets, representing the company's operating capacity                                                                                                                               |                                                                       |
|                           | MV            | market value                                                                 | Size of company                                                                                                                                                                                                              |                                                                       |
|                           | asset         | total assets                                                                 | All assets owned or controlled by the Company                                                                                                                                                                                |                                                                       |

Total asset growth rate(Gra)is the ratio of the total asset growth of the listed company in the current year to the total assets at the beginning of the year, reflecting the growth of the company's assets in the current period. It is generally believed that the higher the index value of the total asset growth rate, the faster the asset management scale expansion of a company in a certain period of time . Our research applied the growth rate of total assets to represent a company's growth capacity.

Long-term debt-to-capital ratio(lev\_1) is the percentage of non-current liabilities as a percentage of long-term capital. Long-term debt-to-capital ratio reflects the long-term capital structure. Since the amount of current liabilities changes frequently, capital structure management primarily uses long-term capital structures. In our study, long-term debt-to-capital ratio represents the solvency of a company.

Total asset turnover rate(TAT) indicates the ratio between asset investment scale and sales level. The higher the turnover of total assets is, the stronger the sales capacity of the enterprise will be, so is the benefit of asset investment. We use the total asset turnover ratio to represent the operating capability of the company.

MV is generally regarded as an indicator of firm size and is a crucial measure of a firm's financial performance<sup>[87,88]</sup>. The market value is applied to represent the size of the company.

Assets was selected because they are indicators of firm size<sup>[89]</sup>. The amount of total assets indicates the total economic resources of the company.

### 3.3 Methods and Model

In order to investigate the influence of social media adoption and usage on firm value, propensity score matching and differences-in-differences analysis (PSM-DID) were employed in this research.

Social media and firm value might be a two-way causal relationship. Despite that fact, we were particularly interested in finding the direction of causal links from social media to firm value, the reason of which is that we wanted to test whether firms were adopting social media merely to follow the trend of social media adoption or whether they used it to create value that justifies the embedded costs. Indeed, most of the prior studies have been based upon the causal relationship<sup>[11, 12, 29, 30, 69, 90]</sup>. Thus, in line with prior studies, the model of the study is presented below:

$$\begin{aligned} \text{Tobin } Q = & \beta_0 + \beta_1 \times \text{did} + \beta_2 \times \text{lev\_1} + \beta_3 \times \text{Gra} + \beta_4 \times \text{TAT} + \\ & \beta_5 \times \text{ROA} + \beta_6 \times \text{MV} + \beta_7 \times \text{asset} + \varepsilon \end{aligned} \quad (2)$$

The "Tobinq" is a measure of the impact of social media adoption on corporate value. The "did" is a dummy variable that indicates whether companies adopts social media. Longterm gearing ratio (lev\_1), rate of return on total assets (ROA), growth rate of total assets (OWN), capital intensity(TAT), market value (MV) and total assets (asset) are a series of control variables. Detailed explanations are in Sections 3.1 and 3.2.

## 4 Empirical results

### 4.1 Multiphase PSM-DID results

#### 4.1.1 Parallel trend

The premise of unbiased estimation results by the differential method is that the hypothesis of parallel trend is satisfied between the experimental group and the control group. In other words, in order to verify the parallel trend hypothesis, the treatment group and the control group should have the same changing trend before the occurrence of the event. Otherwise, the different method will overestimate or underestimate the effect of the occurrence of the event.

We adopted the event study method to conduct a parallel trend test to obtain more accurate and scientific conclusions regarding multi-period PSM-DID. First, we generated the interaction items between the dummy variables of the year and the dummy variables of the treatment group. Regression analysis was conducted with these interaction items as explanatory variables. The coefficient of the interaction item reflects the difference between the treatment group and the control group within a given year. We particularly hope to see that the coefficient of the interaction item between the dummy variable before the point of social media application and the dummy variable in the treatment group is not significant. The experiment took the quarter before application of the social media as the reference benchmark, with a value of 0.

The abscissa of Fig. 1 represents time, where the " $d_{-i}$ " represents the  $i$  quarter before the adoption of social media, and the " $d_i$ " represents the  $i$  quarter after the adoption of social media. The vertical axis in Fig. 1 shows the difference between the treatment group and the control group in the result variable. If the curves of the result variable of the treatment group and the control group are parallel before the application of social media, then the difference between the treatment group and the control group will be constant. As a result, the vertical axis, relative to the reference point, should be 0. As can be seen from Fig. 1, the vertical axis values before the two social media registrations are indeed around 0, which is in line with the hypothesis of parallel trend. In addition, it is worth noting that we found that the operation of short video social media platform was effective: the value of the vertical axis after the registration of short video account began to deviate from 0; the second chart in Fig. 1 shows that this trend emerged after the registration of short video account. The confidence interval indicates whether the vertical axis is significantly different from 0. If 0 points are included, it is not significantly different from 0. Therefore, the vertical axis value for the first two quarters of the short video account registration is indeed 0 which indicates that it strictly conforms to the parallel trend.

#### 4.1.2 Propensity score matching

In order to test the reliability of the matching results, the first step of the analysis in this paper was to conduct the PSM method, where the model was conducted with a set of control variables: assets, return on total assets, long-term debt to capital ratio, size, growth rate of total assets, total asset turnover rate. The  $K$  near neighbor matching method was used to match the samples. We then obtained the matching check for

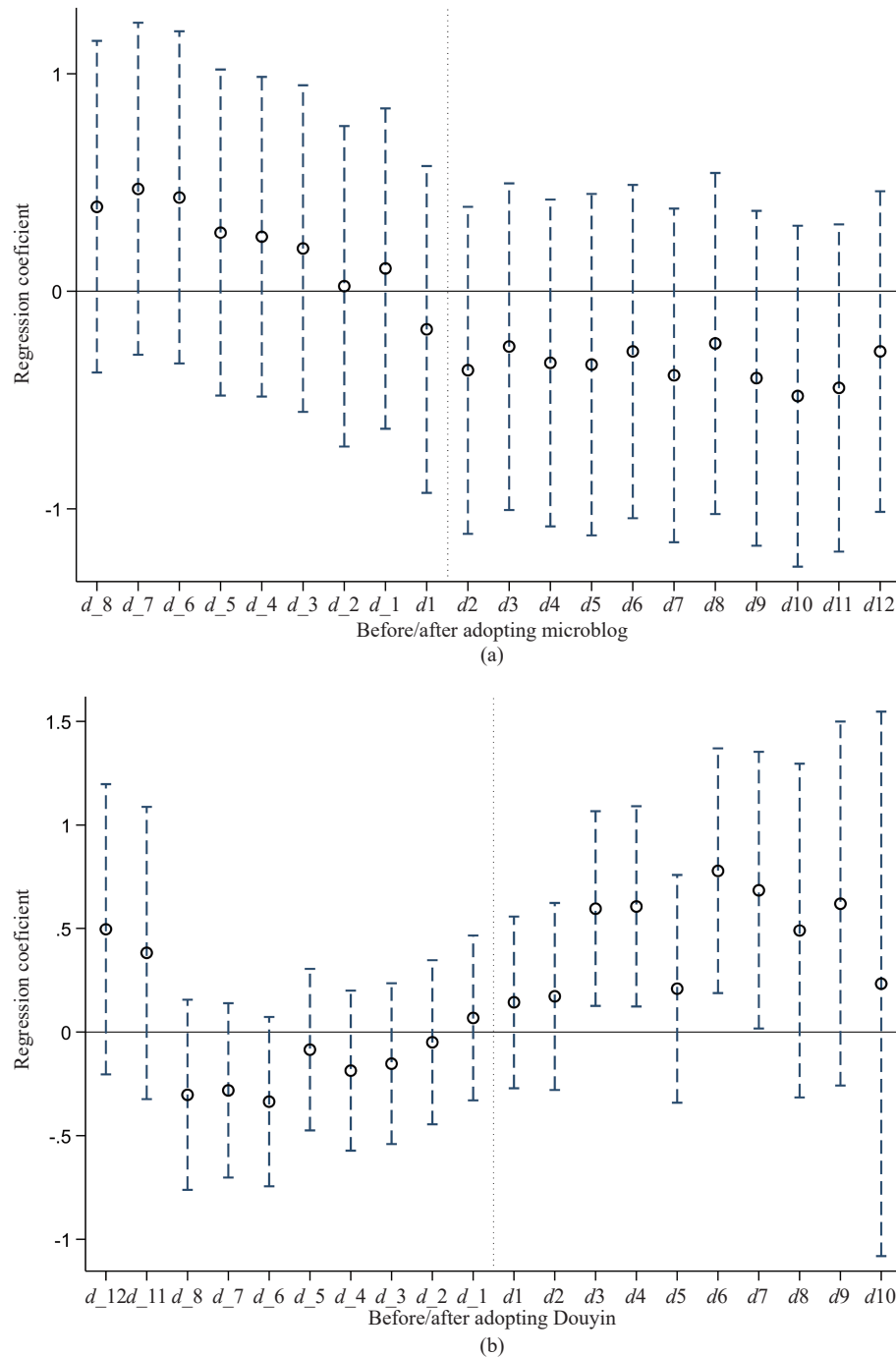


Fig. 1. Parallel trend test.

the distribution of the covariates between the processing group and the control group. Table 2 and Table 3 display the results of the analysis

As can be seen from Tables. 2 and 3,  $t$  values of all variables are less than 1.96, indicating that all control variables have passed the balance test at the significance level of 5%, showing that there are systematic differences between the treatment group and the control group.

The results of variables demonstrated that the standardized deviation of most variables after matching was less than 10%, which seemed acceptable. Whereas, we found that the results of most  $T$ -tests could not reject the null hypothesis, namely, there was no systematic difference between the treatment

group and the control group. More intuitively, it is the standardized deviation of each variable output that can be seen in t can be seen in Fig. 2.

As shown in Fig. 3, after the matching process, the probability density of the propensity scores of the experimental group and the control group were close to each other, indicating that the matching effect was good. Therefore, the feasibility and rationality of the PSM-DID method were further proved on the basis of the common supporting hypothesis.

#### 4.1.3 Differences-in-differences

In this section, Table 4 demonstrates the estimated impact of

**Table 2.** The PSM validity test : Sina microblog.

| Variable | Group | Obs | Mean     | Std. Err. | Std. Dev. | 95% Conf. | Interval | <i>t</i> |
|----------|-------|-----|----------|-----------|-----------|-----------|----------|----------|
| lev_1    | 0     | 431 | 0.089448 | 0.005856  | 0.121564  | 0.077939  | 0.100957 | −0.7295  |
|          | 1     | 566 | 0.096062 | 0.006534  | 0.155447  | 0.083228  | 0.108895 |          |
| Gra      | 0     | 431 | 0.02527  | 0.005333  | 0.110709  | 0.014789  | 0.035752 | −0.7592  |
|          | 1     | 566 | 0.030894 | 0.00503   | 0.119659  | 0.021015  | 0.040773 |          |
| TAT      | 0     | 431 | 0.329404 | 0.011114  | 0.230727  | 0.30756   | 0.351248 | −0.1762  |
|          | 1     | 566 | 0.33208  | 0.010202  | 0.242703  | 0.312043  | 0.352118 |          |
| ROA      | 0     | 431 | 0.023319 | 0.001898  | 0.039411  | 0.019587  | 0.02705  | −1.1506  |
|          | 1     | 566 | 0.027033 | 0.002418  | 0.05753   | 0.022284  | 0.031783 |          |
| asset    | 0     | 431 | 4.27E+09 | 2.49E+08  | 5.17E+09  | 3.78E+09  | 4.76E+09 | −1.4743  |
|          | 1     | 566 | 4.81E+09 | 2.55E+08  | 6.07E+09  | 4.31E+09  | 5.31E+09 |          |
| MV       | 0     | 431 | 8.09E+09 | 4.28E+08  | 8.88E+09  | 7.25E+09  | 8.94E+09 | −1.2317  |
|          | 1     | 566 | 8.8E+09  | 3.82E+08  | 9.09E+09  | 8.05E+09  | 9.55E+09 |          |

**Table 3.** The PSM validity test : Short video platform.

| Variable | did | Obs | Mean     | Std. Err. | Std. Dev. | 95% Conf. | Interval | <i>t</i> |
|----------|-----|-----|----------|-----------|-----------|-----------|----------|----------|
| lev_1    | 0   | 166 | 0.071205 | 0.00764   | 0.098431  | 0.056121  | 0.086289 | −1.0565  |
|          | 1   | 334 | 0.084499 | 0.008014  | 0.146469  | 0.068733  | 0.100264 |          |
| Gra      | 0   | 166 | 0.008622 | 0.007926  | 0.102124  | −0.00703  | 0.024272 | −0.6375  |
|          | 1   | 334 | 0.014225 | 0.004784  | 0.087434  | 0.004814  | 0.023636 |          |
| TAT      | 0   | 166 | 0.288647 | 0.014091  | 0.181546  | 0.260826  | 0.316469 | −0.6723  |
|          | 1   | 334 | 0.300631 | 0.010434  | 0.190688  | 0.280106  | 0.321156 |          |
| ROA      | 0   | 166 | 0.041025 | 0.004139  | 0.053329  | 0.032853  | 0.049198 | 0.0091   |
|          | 1   | 334 | 0.040975 | 0.003325  | 0.06076   | 0.034435  | 0.047515 |          |
| asset    | 0   | 166 | 1.20E+10 | 1.86E+09  | 2.39E+10  | 8.35E+09  | 1.57E+10 | −1.0611  |
|          | 1   | 334 | 1.47E+10 | 1.50E+09  | 2.74E+10  | 1.17E+10  | 1.76E+10 |          |
| MV       | 0   | 166 | 4.53E+10 | 9.65E+09  | 1.24E+11  | 2.63E+10  | 6.44E+10 | −0.8622  |
|          | 1   | 334 | 6.18E+10 | 1.26E+10  | 2.30E+11  | 3.70E+10  | 8.66E+10 |          |

PSM-DID methods on the opening of social media from June 2009 to September 2020. The key variable is the “did”. The financial indicator is added as the control variable subsequently. As can be seen from the results of the PSM-DID, the *p*-value of the “did” variable of the microblog platform is always larger than 0.05, which means that the operation of Sina microblog accounts has no significant impact on firm value. However, the *p*-value of the “did” variable of the short video platform is less than 0.01, meaning that the operation of Douyin short video accounts has a positive impact on the company. There are obvious differences between the adoption of the two platforms.

## 4.2 Robustness checks

### 4.2.1 Alternative operationalization of variables

In this section, we will conduct robustness checks to ensure the consistency of our findings. First, we compute Tobinq in an alternate fashion as documented in extant research, of which the result is documented in Table 5 under the column *R1* (Microblog) and the column *R2* (short video). As can be seen from Table 5, the correlation and significance did not

change, indicating that they passed the robustness test.

### 4.2.2 Shrink tail processing

Our original big data set was indented, leaving the others unchanged. As can be seen from Table 6, the correlation and significance did not change, indicating that they passed the robustness test.

## 4.3 Heterogeneity analysis

Enterprise heterogeneity refers to the differences in holding type, industry category, enterprise age, enterprise size, etc. Scholars have found that enterprise heterogeneity is an important factor that significantly affects enterprise development. As it has been verified above that the adoption of Sina has no significant impact on firm value, we use the data of the short video platform to explore the different effects of the property, industry and scale of enterprises.

### 4.3.1 State-owned impact

As is known to all, state-owned enterprises play a critical role in China, where the center of information release and public opinion has gradually shifted to social media in the internet



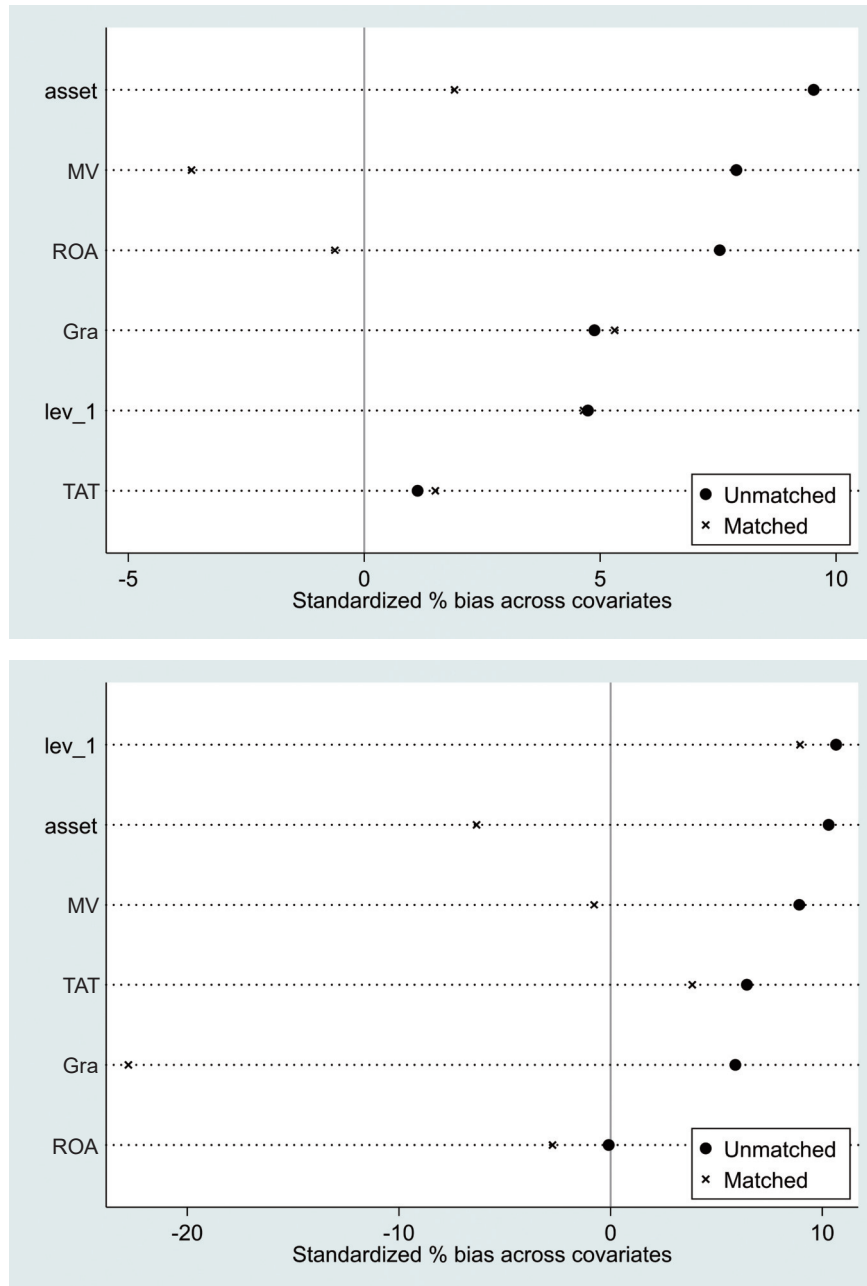


Fig. 2. Standardized deviation graph for variables.

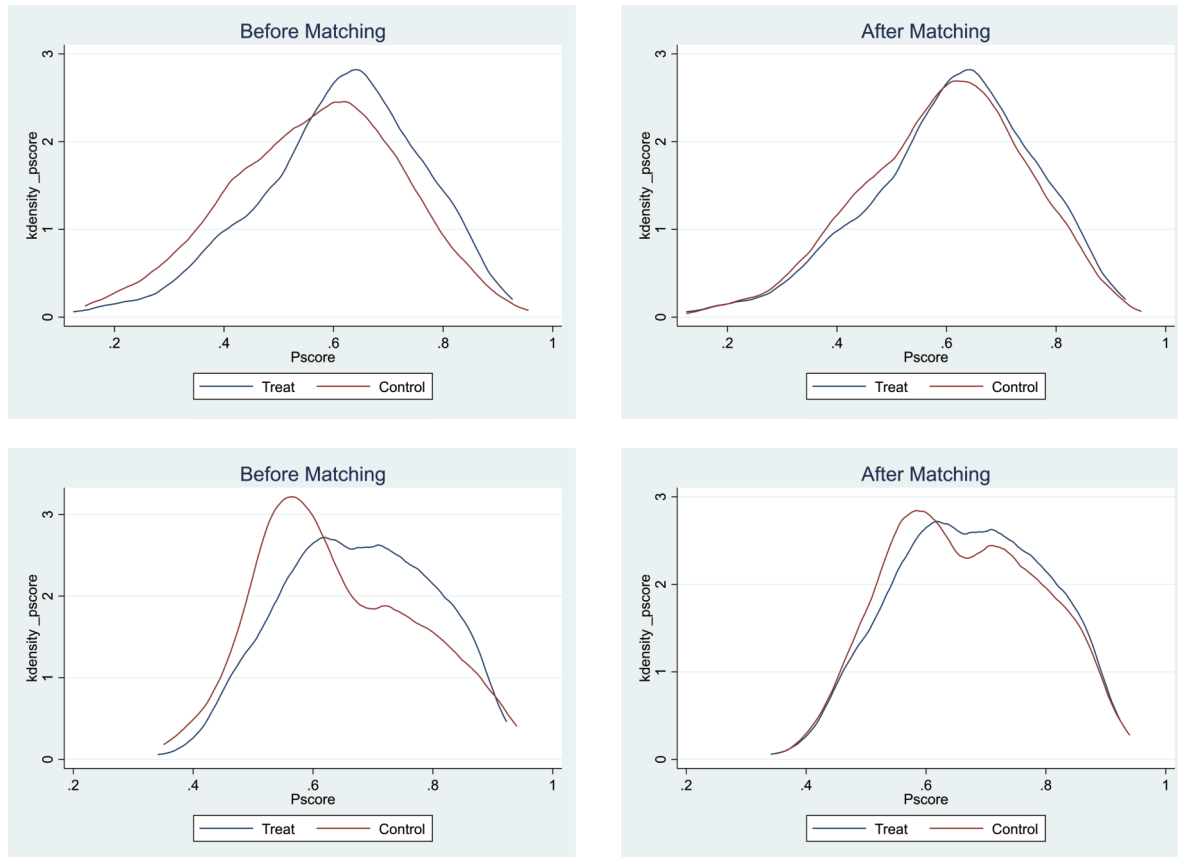
era. With its inherent technological advantages, social media has gradually developed into a major force for integrating social relations and media publicity, which has greatly changed the way of establishing corporate image and has far-reaching influence on the development of enterprises<sup>[91]</sup>. Therefore, in China, exploring the impact of enterprise heterogeneity is inseparable from discussing state-owned enterprises and non-state-owned enterprises.

In this study, the dummy variable(property) reflecting state-owned enterprises is set, which is 1 for state-owned enterprises and 0 for non-state-owned enterprises. It can be seen from model (1) in Table 7 that the coefficient of property=1 is 0.304, which is significant at the 5% level, indicating that if the user is a state-owned enterprise, there will emerge a significant positive impact on the firm value after operating a short

video account; however, for a non-state-owned enterprise, the result will be different, because the coefficient of property=1 is not significant at the 5% level. It is possible that the diversified communication themes and flexible and playful communication forms of social media will make the corporate image diversified and three-dimensional<sup>[92]</sup>, which may break the existing stereotypical impression of the audience on state-owned enterprises, shorten the distance between state-owned enterprises and consumers, and create better customer relationships and customer value. Therefore, the positive effect of social media participation seems to be more substantial in state-owned enterprises.

#### 4.3.2 Industry characteristics

Following the theory of industrial organization, the business



**Fig. 3.** Kernel density map before and after matching.

strategy of an enterprise will be affected by the whole industry, so enterprises should also pay attention to the influence of the industry when using social media. This study takes different industries as the starting point to add the dummy variable(industry). If the enterprise is in the wine, beverage and refined tea manufacturing industry, the value will be assigned to 1; if the enterprise is in the accommodation industry, the value will be assigned to 2; and the value of enterprises in the catering industry will be assigned to 3. Test results are shown in model (2) in Table 7. It can be seen from model (2) that the coefficients of the three industries are all positive and significant at the level of 5%, indicating that enterprises in these three industries have the advantage of enhancing corporate value by operating social media. In addition,

by comparing the coefficients, it is found that this advantage was more pronounced in the accommodation industry. It is possible because that the accommodation environment can be sufficiently represented through pictures and videos and food can be represented through taste in most cases.

#### 4.3.3 Scale impact

Scale is the logarithm of the total assets of an enterprise<sup>[93]</sup>. Practice has proved that there is a certain scale effect in enterprises, that is, specialized division of labor accelerates the proficiency of a particular function, promotes technological progress, reduces production costs and affects firm value<sup>[94]</sup>. Compared with small enterprises, large enterprises are more

**Table 4.** PSM-DID estimates with a fixed time window.

| Tobinq | Sina microblog (45 quarters) | Douyin (11 quarters)   |
|--------|------------------------------|------------------------|
| did    | -0.4655853<br>(-1.5)         | 0.2772761<br>(2)**     |
| lev_1  | 1.183083<br>(1.54)           | -1.765921<br>(-2.02)** |
| Gra    | 0.2229937<br>(0.33)          | -1.301148<br>(-1.99)** |
| TAT    | 1.804113<br>(2.77)**         | 1.641965<br>(2.26)**   |
| ROA    | -1.474349<br>(-0.68)         | 9.439329<br>(5.03)***  |
| asset  | -3.21E-10<br>(-7.59)***      | -9.29E-12<br>(-0.54)   |
| MV     | 1.77E-10<br>(8.94)***        | 5.04E-12<br>(5.25)***  |

Significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .

**Table 5.** Robustness check: Estimation of firm value(replace tobinq).

| Tobinq <i>B</i> | <i>R1</i>               | <i>R2</i>               |
|-----------------|-------------------------|-------------------------|
| did             | −0.6241399<br>(−1.62)   | 0.3907309<br>(2.29)**   |
| lev_1           | 1.049322<br>(1.1)       | −3.352976<br>(−3.11)*** |
| Gra             | 0.1951817<br>(0.23)     | −1.708397<br>(−2.13)**  |
| TAT             | 2.31142<br>(2.86)**     | 1.437124<br>(1.69)      |
| ROA             | −3.270313<br>(−1.22)    | 12.44352<br>(5.39)***   |
| asset           | −3.22E-10<br>(−6.12)*** | −8.61E-12<br>(−0.41)    |
| MV              | 1.88E-10<br>(7.68)***   | 4.99E-12<br>(4.23)***   |

Significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .

**Table 6.** Robustness check: Estimation of firm value(winsor treatment).

| Tobinq | <i>R3</i>               | <i>R4</i>               |
|--------|-------------------------|-------------------------|
| did    | −0.4689141<br>(−1.5)    | 0.2945636<br>(2.09)***  |
| lev_1  | 1.157238<br>(1.5)       | −1.792811<br>(−2.02)*** |
| Gra    | 0.1833925<br>(0.27)     | −1.350498<br>(−2.02)**  |
| TAT    | 1.79627<br>(2.75)**     | 1.718906<br>(2.33)**    |
| ROA    | −1.554451<br>(−0.72)    | 9.7487<br>(5.13)***     |
| asset  | −3.08E-10<br>(−7.06)*** | −8.18E-12<br>(−0.47)    |
| MV     | 1.67E-10<br>(7.98)***   | 4.99E-12<br>(5.12)***   |

Significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .

**Table 7.** Heterogeneity analysis results.

| Tobinq | Property(1)            |                         | Industry(2)             |                      |                        | Scale(3)                |                          |
|--------|------------------------|-------------------------|-------------------------|----------------------|------------------------|-------------------------|--------------------------|
|        | property=0             | property=1              | industry=1              | industry=2           | industry=3             | scale=0                 | scale =1                 |
| did    | 0.544<br>(1.22)        | 0.304<br>(2.43) **      | 0.296<br>(2.27)**       | 2.132<br>(2.57)**    | 0.490<br>(4.1) ***     | 0.498<br>(2.11)**       | −0.076<br>(−0.72)        |
| lev_1  | 0.2008<br>(0.25)       | −1.741<br>(−1.93) *     | 0.052<br>(0.12)         | −6.553<br>(−1.62)    | −4.669<br>(−5.72) ***  | 0.198<br>(0.33)         | 2.159<br>(2.42) **       |
| Gra    | −0.473<br>(−0.35)      | −0.221<br>(−0.64)       | −0.228<br>(−0.64)       | −0.788<br>(−0.28)    | 1.230<br>(1.73)        | −0.704<br>(−0.7)        | −0.483<br>(−1.77) *      |
| TAT    | 1.947<br>(1.08)        | 0.694<br>(1.72) *       | 1.903<br>(3.25)***      | −0.073<br>(−0.05)    | 1.578<br>(2.81)**      | 0.353<br>(−0.34)        | 0.509<br>(1.53)          |
| ROA    | 5.024<br>(1.36)        | 7.177<br>(4.83) ***     | 4.402<br>(3.18) ***     | 15.404<br>(−1.15)    | −7.509<br>(−2.27) *    | 3.878<br>(1.44)         | 3.437<br>(2.79) ***      |
| asset  | −1.29E-10<br>(−0.44)   | −2.87E-11<br>(−2.24) ** | −3.31E-11<br>(−2.39) ** | −3.13E-10<br>(−1.13) | 1.31E-09<br>(−1.72)    | −2.96E-10<br>(−1.08)    | −3.11E-11<br>(−3.14) *** |
| MV     | 1.99E-10<br>(5.84) *** | 5.74E-12<br>(8.25) ***  | 5.91E-12<br>(7.91) ***  | 5.12E-11<br>(−0.47)  | 4.57E-10<br>(3.53) *** | 2.74E-10<br>(13.34) *** | 5.77E-12<br>(10.86) ***  |

Significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .

likely to generate economies of scale, form a more specialized division of labor, and effectively improve the enterprise operation and management<sup>[95]</sup>. In our research, the scale larger than the average sample is assigned as 1, otherwise, 0.

Based on the model (3) in Table 7, the coefficient of scale=0 is 0.498, which is significant at 5% level, indicating that small-scale listed companies have such advantages, that is, operating short video accounts has a significant positive impact on firm value. However, when scale=1, the result is negative and insignificant at 5% level, indicating that the social media participation of large-scale listed companies has no

significant impact on firm value, and may even be negatively correlated. There is a chance that the scale enlargement of the listed company, where the business is more complicated, aggravates the information asymmetry between managers and owners. Due to delays in disclosure on social media, the asymmetric cannot be eased, making it under the supervision where weaker moral risks management is more likely to happen, damaging the interests of shareholders, thus to slow down the increase rate of firm value<sup>[94]</sup>. Moreover, large scale will increase the complexity of management levels, bloat organizational structure and rise internal coordination costs.

Therefore, in some countries or industries, the performance of some large enterprises is low<sup>[94]</sup>.

## 5 Discussion and conclusion

This study verifies the relationship between the application of social media (microblog and short video platform) and firm value, and finds that the application of the two social media platforms have different influences on firm value. We find that, different from the western scenario, the operation of enterprise microblogs in China has no significant impact on firm value. Moreover, in China, the adoption of the emerging social media platform—short video platform, can significantly improve firm value. The results show that there are a significant difference between the adoption of microblog and the adoption of short video platforms.

Company messages posted on Sina microblog can up-regulate the exposure rate, attract the attention of consumers, enable consumers to make purchase decisions and investors to make investment decisions, and positively impact firm value, whereas it ignores the special application scenarios of Sina microblog in China.

(I) First, the microblogging mechanism dilutes its impact. Influential modules (e.g., microblog hotspots, microblog super spots, and microblog hot searches) are not friendly to businesses. On the one hand, the content in the popular modules above is more concerned with celebrities, emotional topics, social hot spots and others, while the information regarding the company's products and services/brand value is rarely shown in the popular modules above, thereby causing excessive investment in the marketing of microblogs by merchants with less returns. On the other hand, the occasional appearance of company news in the popular modules of the mentioned microblog is more of a negative one, which creates a massive market of potential customers for the company.

(II) Second, it is the issue of traffic fees, thereby limiting the reach of microblogs. Before 2015, the cost of 4G mobile traffic and other communication services in China remains relatively high. The penetration rate of the internet and smart mobile terminals is far less than now, and the marketing ability of social media has not been comprehensively reflected. Comparing with marketing in the microblog field, traditional marketing means (e.g., TV advertisement, email advertisement and webpage pop-up) have a higher rate of return, while the microblog marketing strategy at that time is more concerned with celebrity effect and interactive theme marketing<sup>[81]</sup>. The way of social media marketing is not mature, and social media marketing has aroused insufficient attention. Companies just following the trend of opening microblog accounts and posting on social media have no marketing value, so the company cannot get the corresponding return on investment.

(III) Third, it is the impact of relevant regulations on China's securities regulatory mechanism, thereby reducing the information disclosure ability of the microblog platform. The China Securities Regulatory Commission(CSRC) does not allow companies to post their financial information on microblogs ahead of prescribed platforms (e.g., stock exchanges). The public knows more about financial investment information (e.g., company financial status) from the CSRC and com-

pany official websites, other than microblogs. Thus, the information disclosure function of microblogs is insignificant.

Adoption of Douyin app significantly increases firm value.

① With the decline of 4G mobile traffic price and the continuous development of mobile terminals, the number of users of the short video platform has surged, and users have been long used them. Given the data of China Internet Network Information Center(CNNIC), as of June 2020, the scale of China's short video users is 818 million, taking up 87.0% of the total internet users. According to the latest survey, the average daily usage time of China's short video users has reached 110 min (the operation and development trend analysis of the user scale of China's short video industry in 2020). It has gradually become a short video platform gathering consumers, which creates a huge market of potential customers for the company. ② The short video user group is the age group that exhibits high consumption power. According to the CNNIC, as of June 2021, users aged 20-49 take over half of the total number of netizens, accounting for 56.4%. Moreover, the company releases more dynamic and comprehensive content on the short video platform with flexible presentation methods (e.g., situational short films, slides, pictures and texts). Users can gain comprehensive insights into the company's business and corporate culture on the short video platform, pass on brand value, and narrow the gap between firms and consumers. Next, the scene type of short video marketing is easier to arouse emotional resonance, build customer trust, form customer groups and increase marketing revenue. ③ A positive corporate image can be built through proper image management on social media platforms, which helps improve firm value. Since the lightweight, diversified and information-rich content on the short video platform is easy to be accepted by customers, timely investment in the short video field benefits the enterprise.

## 6 Implications and limitations

### 6.1 Implications

This study provides insights into the adoption and value of social media in China. First, this study verifies the relationship between the application of the microblog and firm value in China. Although some foreign studies have verified the impact of the application of microblog platforms (e.g., Facebook and Twitter) on companies, the situation in China, as a rapidly developing emerging market, is different from that in foreign nations. Quarterly financial data from 2009-2020 and information on whether companies are using social media accounts as of September 2020 are used to create a dataset spanning multiple periods. Subsequently, the multi-period PSM-DID method is used to reduce the endogenous level of panel data, and an empirical analysis is conducted on this dataset. The final results verify the relationship between the adoption of social media and firm value in China. This study provides some insight into the adoption and the value of social media in China.

Second, different from the existing single social media platform research, this study validates the role of the adoption of the recently emerging short video platform on firm value. This study pays attention to consumer preferences, ad-

justs social media strategy, uses modern short video resources and adopts the emerging social media platform. It provides novel ideas and perspectives for the study on social media capabilities in dynamic capability theory, and lays a theoretical basis for enterprises to make decisions on channel expansion of social media platforms, thereby broadening the previous research field of social media. This study selects Douyin, which can represent China's short video platforms to research. A dataset is created, which spans multiple periods with the financial data from March 2017 to September 2020, as well as the information of whether the company adopts Douyin by September 2020. Subsequently, the propensity value matching score method is adopted to reduce the endogenous of the panel data. Lastly, the method is used to regression the data. The final results confirm the positive impact of the application of short video platforms on firm value. Empirical results encourage the companies without operating a short video to open a short video account and actively share post to interact with users, all-round display the company's products and services, as well as brand value, in order to increase sales and enhance firm value.

Third, this study scope comprises three industries, while the scope of previous studies is mostly a single industry (e.g., manufacturing industry, hotel accommodation industry, retail industry and computer industry). This study provides a direction for the future social media strategy of China's catering and accommodation industry. In other words, investment in the emerging short video platform is of higher significance than that in the microblog platform. To be specific, the subsequent social media operation should stress the emerging social media (short video social media platform, even the emerging social media platform after short video in the future). In other words, investment in an emerging short video platform is more significant than that in a microblogging platform.

Fourth, this study finds that in China, the application of microblogs or short video platforms had different effects on firm value. The application of the microblogs has no significant impact on firm value, while the application of short video platforms has a significant positive impact. Accordingly, this study gains an important management inspiration, i.e., in China, enterprises should focus on applying emerging social media platforms, which can bring better investment returns to the companies.

Lastly, existing social media research have often ignored the endogeneity of data. In this study, the PSM method can be used to explore the impact of social media participation on firm value in a more objective, real and dynamic manner, which can improve the strength of evidence, regulate the confusion and prevent bias. This study uses the fixed effect model of panel data to reduce the endogeneity problems caused by omitted variables. The multi-period PSM-DID method is used to further reduce sample selection bias and endogeneity problems, which can enrich the empirical research results of corporate participation in social media and be effectively referenced for relevant empirical research.

## 6.2 Limitations and future research

This study has the following limitations. First, this study only uses Sina microblog and Douyin short video platform for

verification. The role played by other platforms has not been verified through research, and it is recommended to verify other platforms in the future. Subsequent research can explore how the quality of social media platforms impacts the value of a company. Quality can be measured in a wide range of manners, such as Baidu Index user stock or user increment, etc. Second, this study only discusses the impact of the "adoption" of social media on firm value. In fact, some companies may operate their social media accounts more carefully than others, which are reflected as more posts and updates, more interactions with followers. Subsequent studies can investigate the "operational quality" effects of social media adopted. Third, this study only explores the relationship at the company level, without an in-depth investigation of the impact of specific information content released by the company on microblogs and short video platforms on firm value. Fourth, the collection of Douyin data in this study was limited to 2017-2020. Considering that the behavior of social media users will change over time, subsequent research on short video platforms can be extended to cover multiple periods for dynamic analyses to gain additional insights. In addition, subsequent research can start from the characteristics of companies to conduct heterogeneity analysis, and explore the differences in the use of social media by different types of companies from the aspects of age and growth potential of companies.

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## Conflict of interest

The authors declare that they have no conflict of interest.

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