

# Can Digital Financial Behavior Improve the Effect of Prevention and Control of COVID-19 in China?

Sheng Wang<sup>1,2</sup>

<sup>1</sup> Department of Finance, Fuzhou University of International Studies and Trade, Fuzhou, Fujian, 350202, China

<sup>2</sup> America Consulting Group, Inc., 2955 Grand Concourse, Bronx, NYC, NY 10468, USA

Correspondence: Sheng Wang, School of Finance and Accounting, Fuzhou University of International Studies and Trade, Fuzhou, Fujian 350202, China. Tel: 1-132-5506-6365. E-mail: fw107@foxmail.com, 1294539992@qq.com

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## Abstract

**Background:** Before December 2019, white lung patients with symptoms similar to COVID-19 pneumonia were found in the United States and some European countries. After COVID-19 pneumonia was diagnosed in Wuhan, China, in December 2019, almost all countries or regions in the world have successively reported cases of COVID-19 pneumonia. 2020 is the most critical year for all mankind to fight against the new crown pneumonia epidemic. There are many prevention and control measures adopted by various countries or regions for the epidemic of new coronavirus pneumonia, and digital financial behavior (DFB) is an important evaluation index for effective prevention and control measures, which is of very Chinese characteristics.

**Methods:** DFB is defined by the Digital Financial Inclusion Payment Index, although there may be various versions of the understanding and definition of DFB. The data of the new crown pneumonia is calculated and accumulated through the real-time monitoring data published on the website of the health commissions of 31 provinces and municipalities directly under the central government every month, and is the first-hand raw data. Under the strict prevention and control measures adopted by China, these real-time data on new crown pneumonia released by various places are objective, true and comprehensive. The analysis methods adopted in this paper mainly include statistical analysis methods, econometric models such as logarithmic linear regression model, exponential model simulation method, etc.

**Results:** The diagnosis of COVID-19 pneumonia infection is a random variable, and there is a nonlinear random exponential relationship between it and DFB. The empirical study found that the least square estimation of COVID-19 infection diagnosis and DFB constitute a statistically significant exponential function relationship. This index model has successfully measured the effect of COVID-19 epidemic prevention and control in China with statistical significance, which indicates that DFB plays a positive role in improving the effect of COVID-19 epidemic prevention and control in China. The nonlinear exponential relationship between individuals with cumulative diagnosis of COVID-19 infection and DFB in 31 provinces and municipalities directly under the Central Government of China, excluding Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan Province, has proved that this relationship is robust. Through regression analysis, it is found that the number of people infected with COVID-19 is significantly increased by one person for every additional unit of DFB. However, the similarity of DFB in 31 provinces and municipalities directly under the Central Government of China indicates that the number of COVID-19 infected individuals in 31 provinces and municipalities directly under the Central Government is increasing slowly. This result is very consistent with the distribution of actual statistical data, although the relevant data have certain regional differences.

**Conclusion:** With extensive and in-depth practical basis and practical significance in all levels of Chinese society, DFB can measure the positive effect of the prevention and control of COVID-19 epidemic in China. Based on the positive role of DFB, there is every reason to believe that DFB will be one of the indispensable and trustworthy factors to improve its prevention and control performance in the face of similar social highly infectious diseases that may occur in the future. Whether the research method here has wider applicability, that is, whether it has a statistically significant positive effect on the prevention and control of epidemics in other countries or regions, should be a question that needs to be further explored in the future.

**Keywords:** COVID-19, epidemic prevention and control, digital financial behavior, digital inclusive financial payment index

## 1. Introduction

Since the outbreak of COVID-19 in the world, countries around the world have experienced the process of fighting against COVID-19 with various resources and means of varying degrees of investment, especially in 2020, the classic year of far-reaching epidemic prevention and control, which determines the development trend of COVID-19 epidemic. Throughout the more than three years since the prevalence of COVID-19, some countries in the world have roughly experienced three stages of evolution in their attitudes towards the prevalence of COVID-19, that is, from the initial contempt, attention to the neglect or “lying flat” of these three stages of cognitive and control changes. The year 2020 is a typical year of connecting the past and the future in the struggle between human beings and COVID-19. It is of great theoretical value and practical significance to take the prevention and control of COVID-19 epidemic situation in this year as the research period.

In addition to the “belittle” and “lie flat” models adopted in the fight against COVID-19, the core idea of the prevention and control of Chinese COVID-19 pneumonia is to attach importance to the specific measures for the prevention and control of COVID-19 pneumonia. The Chinese government has taken four important measures to prevent and control the prevalence and spread of COVID-19 pneumonia, namely, nucleic acid testing or serum positive antibody testing and screening, widespread vaccination of novel coronavirus vaccine, development of emergency special drugs to treat novel coronavirus pneumonia infection, and strengthening physical epidemic prevention measures, such as wearing qualified masks, keeping enough safety distance between people, doing a good job of personal hygiene, doing a good job of isolation measures key monitoring of health code and big data, etc. (Wang, 2023). These measures to combat the COVID-19 epidemic are strictly implemented in China. Relatively speaking, the prevention and control measures of COVID-19 epidemic situation in other countries in the world are different in tightness, the models of fighting the epidemic situation are also diversified, and the effects of preventing and controlling COVID-19 epidemic are also different. For example, the means of prevention and control of COVID-19 epidemic in countries or regions outside China, in addition to blocking or preventing the spread of COVID-19 through COVID-19 vaccination (Ferranna et al., 2021; Jiang et al., 2021; Wang et al., 2022), are more medical research, revealing that COVID-19 pneumonia is often accompanied by thrombotic inflammatory complications (Afzali et al., 2022; Gorog et al., 2022; Gu et al., 2021; Teuwen et al., 2020), promoting endothelial cell activation and dysfunction (Jin et al., 2020), and mediating inflammation and abnormalities such as coagulation disease, platelet disease and endothelial disease, Further explanation of the pathogenesis will help to develop targeted treatment methods and drugs. Judging the cure probability of COVID-19 infected individuals by the serum positive rate of immunoglobulin IgG and IgM (Cervia et al., 2022; Liu et al., 2021; Lucas et al., 2020) is also a medical evidence for scientific epidemic prevention and control. Under the condition of pulmonary cystic fibrosis, there is at least the possibility of not fully preventing COVID-19 pneumonia infection, which reduces the risk of infection (Bezzetti, 2023). Neutralization assay method is widely used to identify the response of SARS-CoV-2 variant to neutralizing antibody (Chen, 2023; Chmielewska et al., 2021; Merrill et al., 2020; Pinto et al., 2020; Zost et al., 2020). These refined treatment plans play a positive role in medical diagnosis and treatment.

Analyzing the possible development and changes of COVID-19 pneumonia according to epidemiological studies (Ishigami, 2021) is one of the important means to prevent the epidemic disease of COVID-19 pneumonia. On the one hand, from the degree of symptoms and cognitive distribution characteristics of population groups infected by COVID-19, the difference between East and West in the prevention and control of COVID-19 pneumonia has led to significant differences in the epidemic situation of COVID-19, and the epidemic prevention and control model in the East seems to be more excellent (Jamison & Wu, 2021). On the other hand, in terms of physical prevention and control measures, we not only focus on the construction and use of isolation measures, which is conducive to the effective treatment of people diagnosed with COVID-19 infection (Wang et al., 2021), but also provide free time and space for other uninfected people to work, study and live to the maximum extent; Moreover, maintaining social distance has a significant positive effect on the prevention of COVID-19 infection (Lai et al., 2021), especially in terms of travel restrictions, it has a more positive and positive effect on the prevention of COVID-19 infection.

Although the above prevention and control of COVID-19 is in-depth and extensive, the prevention and control of COVID-19 epidemic in many developed countries and even some developing countries, led by the United States, is not optimistic. According to the analysis of real-time data publicly reported by the media, in 2020, the proportion of the cumulative number of confirmed cases of COVID-19 infection in China compared with 212 other countries

in the world, especially compared with the top 81 countries that accounted for 97.98% of the cumulative number of confirmed cases of COVID-19 infection in 213 countries in the world, the distribution chart of their respective proportions is as follows:

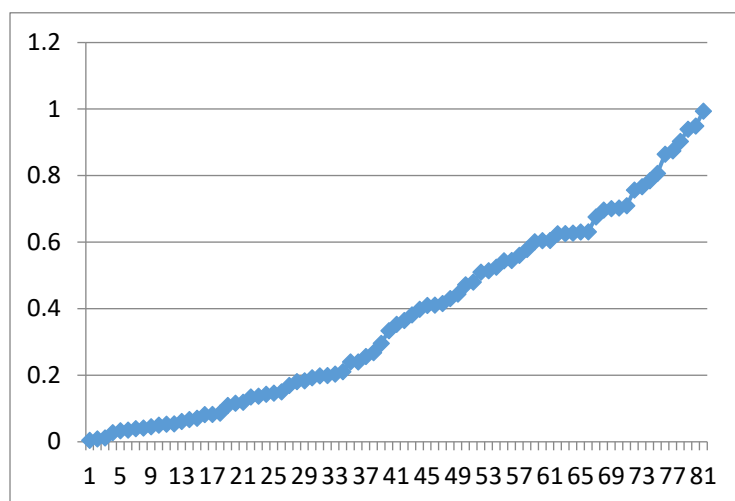


Figure 1. In 2020, the ratio of the cumulative number of people diagnosed with COVID-19 infection in China to the cumulative number of people diagnosed with COVID-19 infection in the top 81 countries in the world

*Notes.* 1 US 2 India 3 Brazil 4 Russia 5 France 6 UK 7 Türkiye 8 Italy 9 Spain 10 Germany 11 Colombia 12 Argentina 13 Mexico 14 Poland 15 Iran 16 Ukraine 17 South Africa 18 Peru 19 Netherlands 20 Indonesia 21 Czech 22 Belgium 23 Romania 24 Chile 25 Iraq 26 Canada 27 Bangladesh 28 Pakistan 29 Philippines 30 Switzerland 31 Morocco 32 Sweden 33 Israel 34 Portugal 35 Austria 36 Saudi Arabia 37 Serbia 38 Hungary 39 Jordan 40 Nepal 41 Panama 42 Japan 43 Georgia 44 Azerbaijan 45 Ecuador 46 Croatia 47 United Arab Emirates 48 Bulgaria 49 Belarus 50 Slovakia 51 Lebanon 52 Dominica 53 Costa Rica 54 Denmark 55 Bolivia 56 Armenia 57 Kazakhstan 58 Kuwait 59 Moldova 60 Qatar 61 Lithuania 62 Palestine 63 Tunisia 64 Greece 65 Egypt 66 Guatemala 67 Oman 68 Myanmar 69 Ethiopia 70 Slovenia Asia 71 Honduras 72 Malaysia 73 Venezuela 74 Bosnia and Herzegovina 75 Paraguay 76 Libya 77 Algeria 78 Kenya 79 Bahrain 80 Ireland 81 Nigeria

*Source:* Baidu website, Health Commission websites of 31 provinces and municipalities.

Figure 1 reveals an important shocking fact, that is, in the highly infectious period of COVID-19 epidemic outbreak in 2020, China's COVID-19 epidemic situation prevention and control achievements are so outstanding, why? Perhaps there are thousands of answers, including the effectiveness of the Chinese style COVID-19 epidemic prevention and control measures (Wang, 2023). However, few scholars discuss this social hot issue from the perspective of digital financial behavior.

Chinese scholars generally set the first year of China's digital finance to 2003 (Huang, 2018), when Alipay was launched, and took the digital inclusive financial index developed by the Digital Finance Research Center of Peking University as the measurement of digital finance (Jia & Liu, 2022; Jiang & Liu, 2021; Li & Liu, 2022; Liu, 2022; Ran & Tan, 2021; Wang & Hu, 2022; Wang & Zhao, 2021; Wang, 2022; Xie & Yan, 2022; Zheng et al., 2022). In this paper, the digital inclusive financial payment index (Note 1) is used as a measure of digital financial behavior. The digital financial behavior mentioned below in this article refers to the digital inclusive financial payment index, namely, the definition of digital financial behavior is the digital inclusive financial payment index.

## 2. Introduction to Data Acquisition and Methods

The sample data of COVID-19 epidemic situation studied in this paper mainly comes from the website of the China's National Health Commission, the websites of the health commissions of 31 provinces and municipalities directly under the Central Government, as well as Baidu web search. A total of 1571 (Note 2) in size samples of COVID-19 infection were confirmed and cured. The data of the 31 digital inclusive financial payment index in 2020 is from the data of the digital inclusive financial payment index compiled by the Digital Finance Research Center of Peking University.

The methods for sample data research in this paper include basic statistical data processing methods, observation

sampling theoretical model construction methods, nonlinear regression analysis methods, and modern statistical analysis methods include probability distribution and data structure distribution map.

The statistical data processing method is mainly used to evaluate the performance of China's epidemic prevention and control in a global perspective. According to the analysis of the collected sample data structure, the appropriate model is selected for scientific and reasonable fitting of the data, and the exponential function method, logarithmic linear regression model and data probability distribution histogram adopted in this paper are the necessary choices for the scientific and reasonable processing process adopted according to the actual characteristics of the sample.

### 3. Results Presentation

Since the mysterious electronic smoke pneumonia broke out in Wisconsin, USA in July 2019, similar pneumonia symptoms also broke out in Wuhan, China in December 2019, and then these pneumonia cases were cumulatively diagnosed as novel coronavirus pneumonia. As time goes by, almost all countries and regions in the world have reported the occurrence of COVID-19 pneumonia infection cases in 2020. Since then, the world has entered a new mode of epidemic, prevention and control of COVID-19. In China, excluding Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan Province, 31 provinces and municipalities directly under the Central Government have all been affected by novel coronavirus. According to the real-time statistical data released by the media, COVID-19 pneumonia cases in China in 2020 are mainly concentrated in Hubei Province, with the cumulative confirmed cases of COVID-19 pneumonia accounting for 77.34% of the 31 provinces and municipalities directly under the Central Government. However, in 2020, the cumulative number of confirmed cases of COVID-19 infection in 81 countries in the world will respectively exceed the cumulative number of confirmed cases in China, and the total cumulative number of confirmed cases of COVID-19 infection in these 81 countries will account for 97.98% of the total cumulative number of confirmed cases in 213 countries including China.

COVID-19 pneumonia is a highly infectious disease in the world in the 21st century (Chen et al., 2022). Over the past three years, it has appeared in almost every corner of the world, which has had a profound negative impact on the social development and economic construction of all countries and regions in the world. During the more than three years of the COVID-19 pandemic, human beings have taken various possible means to contend with it. There are both successful experiences and lessons, which will undoubtedly leave thick historical traces in the history of human civilization! It is both a wake-up call and a spur to the future of human development.

In the past three years or more, COVID-19 pneumonia has spread widely around the world, causing chaos in the order of economic and social development around the world. This global infectious disease has strictly tested the actual actions of more than 200 countries and regions around the world in epidemic prevention and control. As we all know, novel coronavirus pneumonia started in 2019 and broke out in 2020. The year 2020 is the most critical year to examine the effectiveness of prevention and control measures taken by countries and regions in the face of sudden infectious diseases such as COVID-19 pandemic. The subsequent evolution of COVID-19 epidemic in 2021, 2022 and early 2023 is the continuation and development of COVID-19 epidemic in 2020. Based on this fact, the case report in this paper studies the situation in 2020 as a typical time and space for the prevention and control of COVID-19 epidemic, with a view to providing a new perspective for the occurrence of new infectious diseases in the future and taking effective prevention and control measures as a reference.

Among many cases of COVID-19, the Chinese COVID-19 epidemic prevention and control model is one of the most worthy cases to study, which is very typical! The Chinese model for the prevention and control of COVID-19 pneumonia has a strong reference value and practical significance for the prevention and control of various new large-scale infectious viruses that may appear in the world in the future.

The Chinese model, which has performed extremely well in the prevention and control of COVID-19 epidemic in the past three years, is based on the systematic prevention and control measures of COVID-19 epidemic introduced in 2020 (Wang, 2023), and the Chinese model, which constantly optimizes the means of epidemic prevention and control with the development and change of the epidemic, providing useful experience for the whole mankind to face the possible outbreak of large-scale infectious diseases in the future. Figure 1 has highlighted China's extraordinary responsibility in the COVID-19 pandemic, and is an extremely valuable "treasure" for scientific prevention and control of the epidemic. This "wealth" includes the comprehensive implementation of various means of scientific governance of society. For example, digital financial behavior has been popularized by people at all levels of society, and has been practiced in daily study, work and life, forming a Chinese-style "financial behavior model". This kind of digital financial behavior practiced by the whole society has undoubtedly played an extremely important role in the prevention and control of COVID-19 epidemic over the past three years.

Next, we will discuss the prevention and control performance of China's COVID-19 epidemic in 2020 from the perspective of digital financial behavior, and give appropriate scientific evaluation.

#### 4. Discussion

The digital financial behavior is measured by the digital inclusive financial payment index compiled by the Digital Finance Research Center of Peking University. The digital inclusive financial payment index is based on the fact that smart phones are widely used in daily work, life and learning activities, especially in cashless non-contact payment, which is more profound, and its application is the widest and deepest in the world. In Chinese society (excluding Hong Kong Special Administrative Region, Macao Special Administrative Region and Taiwan Province), the daily payment of goods and services through smart phones is widespread in every corner of the country, from urban to rural areas. With the popularization of Alipay and WeChat payment, this digital financial behavior has become efficient, convenient and safe, and has won the conceptual recognition, inner trust and practical support of people from all walks of life. Based on the analysis of nearly 20 years of digital finance practice experience, and with the completion of the digital RMB operation pilot, the full spread of digital RMB will further strengthen the financial behavior of all sectors of the society based on digital RMB. The difference of digital financial behavior across the country is not statistically significant, and its distribution presents a skewed normal distribution, as shown in Figure 2:

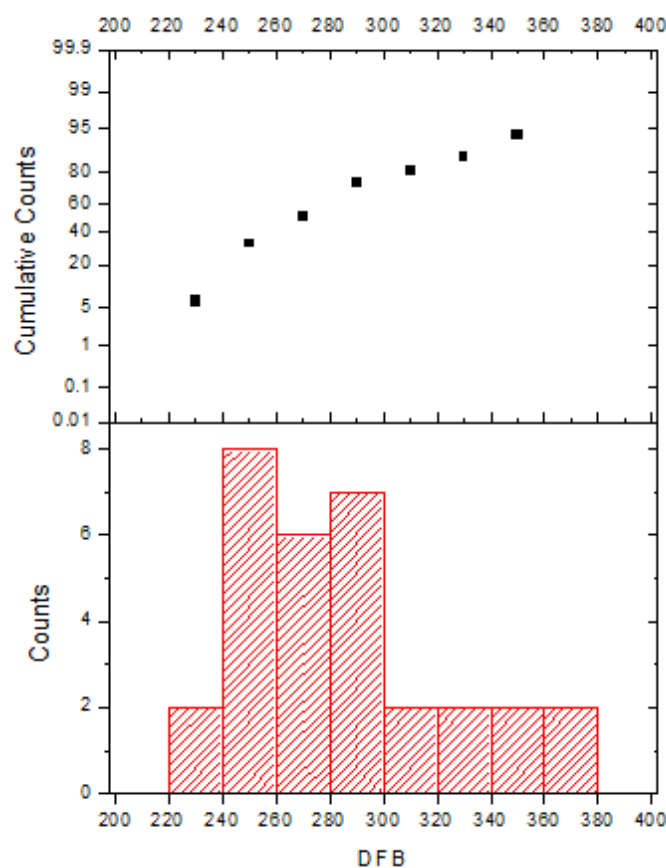


Figure 2. Probability distribution of digital financial behavior

Source: Digital Finance Research Center of Peking University

Although the level of economic and social development in different regions is high and low, and the digital financial behavior in different regions is different in quantity, its essence is statistically consistent and does not show regional differences. The similarity of digital financial behavior across the country has played a positive role in the prevention and control of COVID-19 in the past three years, that is, digital financial behavior has significantly portrayed the performance of COVID-19 prevention and control. Through observation, there is the following exponential relationship between digital financial behavior (DFB) and cumulative confirmed infections

(NCI) of COVID-19, that is

$$NCI(t) = A \times e^{B \times DFB(t) + \mu(t)} \text{ (Note 3)}$$

Where A and B are parameters,  $\mu(t)$  Represents a random disturbance term, and t represents a province or municipality directly under the Central Government.

Regression analysis of the above model's results in the following table:

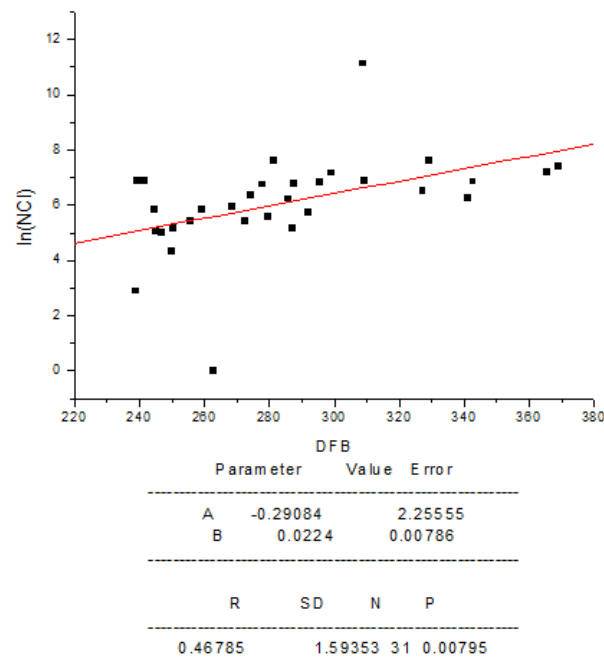


Figure 3. Nonlinear regression analysis between digital financial behavior and the cumulative number of confirmed cases of COVID-19 infection in China in 2020

Based on statistical significance, its explicit functional relationship can be expressed as follows:

$$\widehat{NCI(t)} = e^{-0.29084 + 0.0224DFB(t)}$$

This regression function relationship shows that the relationship between NCI and DFB is nonlinear, its statistical significance is significant, and its relationship is also in line with scientific logic, because it is not only significant at the 1% significance level, but also its random disturbance term basically conforms to normal distribution, as shown in the figure below:

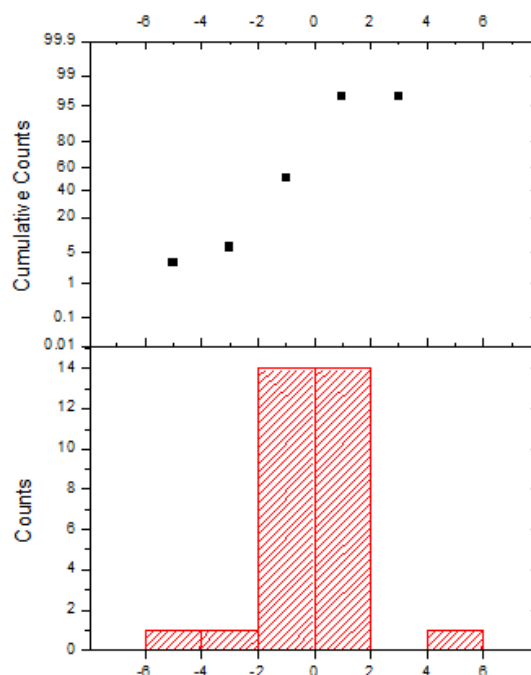


Figure 4. The random disturbance term basically conforms to the normal distribution law

The above functional relationship has positive and significant social support basis and practical value and significance. It is the evolution of digital financial behavior over the past two decades, and the digital financial behavior across the country has basically converged. Digital financial behavior is the mainstream financial practice in China today.

For countries or regions with weak digital financial behavior, whether our conclusions can be applied still needs further observation and research. However, China's practical experience in digital finance shows that the prevention and control of infectious diseases such as COVID-19 is of positive and significant reference value.

In addition to the distribution of the cumulative number of people diagnosed with COVID-19, the recovery rate of COVID-19 infected people is also an important indicator to measure the performance of prevention and control of COVID-19. According to the analysis of real-time record data of epidemic prevention and control in China, it is found that there is a high positive correlation between the cumulative number of confirmed cases of COVID-19 and the cumulative number of recovered cases of COVID-19 infected people in China, which infers that digital financial behavior has a significant positive explanation ability for the recovery of COVID-19 infected people in China, and there is little difference between provinces and municipalities directly under the Central Government. In contrast, in 2020, the relationship between the cumulative number of people diagnosed with COVID-19 infection and the cumulative number of people cured in 212 countries around the world is also highly positive, but the differences between countries are very large. The difference between 212 countries is more than 1749 times that of China's 31 provinces and municipalities.

## 5. Conclusion

The study of COVID-19 infection from the perspective of digital financial behavior and scientific measurement methods provide a new observation window for reference in the prevention and control of large-scale epidemic diseases in the future.

In the academic literature, the term "digital financial behavior" is rarely seen. This paper measures it from the perspective of the digital inclusive financial payment index, which is based on the construction and calculation method of the digital inclusive financial payment index (Guo et al., 2020). Digital financial behavior refers to the digital inclusive financial payment index. The larger the digital inclusive financial payment index, the stronger the digital financial behavior, and vice versa. In 2020, Shanghai is the municipality with the strongest digital financial behavior, while Qinghai is the province with the weakest digital financial behavior. However, no matter whether the digital financial behavior is strong or weak, the performance of the digital financial behavior is the same or

similar, there is no essential difference, only the difference in quantity and degree, and the digital financial behavior is not differentiated in China.

The COVID-19 infection of provinces and municipalities directly under the Central Government is consistent with their corresponding digital financial behavior. Based on statistical analysis, the relationship between them is positive and significant. Such an empirical relationship will play a positive guiding role in the scientific allocation of resources for prevention and control of epidemic diseases in the future, so as to achieve proactive, scientific epidemic prevention, accurate layout, rational allocation of resources, and promote the orderly development of social and economic life. If the positive impact of digital financial behavior on the prevention and control of COVID-19 epidemic is ignored, it is possible to draw a conclusion that the epidemic prevention and control model in the East seems to be more prominent according to the concept of East and West on the prevention and control of COVID-19 epidemic (Jamison & Wu, 2021). In fact, judging from the cumulative number of confirmed cases of COVID-19 pneumonia in 2020, Indonesia, Japan, Malaysia, Myanmar and Filippin in the East all have more confirmed cases than China. If the number of confirmed cases of the epidemic is estimated according to the per capita, China is almost the lowest. If China ranks second in terms of the popularity of digital finance worldwide, who is the first? This demonstrates that the digital financial behavior has a significant positive explanation for the prevention and control of COVID-19 pneumonia in China, that is, the stable global digital financial behavior model strengthens the positive performance of the prevention and control of COVID-19 pneumonia in China. This model is almost the only one that exists at present, since one of the foundations of this model is the normalization of electronic payment models, throughout the world, almost only China can form socialized digital financial behavior through extensive social practice in about two decades.

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### Compliance with Ethics Guidelines

The author declares that there is no conflict of interest or financial conflicts to disclose.

### Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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## Notes

Note 1. Regarding the construction of the digital inclusive financial payment index, it is mainly compiled by the Digital Finance Research Center of Peking University. The ideas and ideas for compiling this index can be consulted in Wang, S. (2022). How to define digital financial behavior is an open question. This article uses the digital inclusive financial payment index to define digital financial behavior, only based on the fact that the electronic payment model has a broad social practice base in China, and it is now a normal daily payment model, and it is regarded as a stopgap measure.

Note 2. This data is calculated and aggregated through real-time data released by 31 provinces and municipalities directly under the central government in China every month in 2020. From January to December, from January to December, from the central to the local government to the local government every month real-time news release of the new crown pneumonia epidemic monitoring report, the real data of the new crown pneumonia epidemic in each province and municipality directly under the central government was recorded one by one without omission, and then through data collation, the objective data of each month was summed up. The reason why these data is true is because according to the management rules of the new coronavirus pneumonia prevention and control in China at that time, if there was a real-time situation of missing and reporting individuals infected with the new coronavirus pneumonia in any place, the main local officials were subject to severe punishments, including dismissal, administrative punishment and judicial prosecution. Under the strict management measures adopted during this special period, it is extremely impossible for any competent official to artificially conceal, report and omit the real-time situation of the new coronavirus pneumonia epidemic at the subjective level. Therefore, the data for each outbreak used in this article are very reliable and objective.

Note 3. The establishment of functional relationships between variables contains at least two ideas, one is a functional relationship based on a clear causal relationship, and the other is an observable functional relationship based on a certain "cointegration" relationship between variables. The exponential function relationship here belongs to the latter. The causal relationship between variables with cointegration is often very obscure, and it is possible to see the "causal relationship" clearly after some transformation. The establishment of the second functional relationship is often more complicated, and the easiest way to establish the functional relationship between variables is to establish the functional relationship between them through observation methods. The functional relationship between DFB and NCI is based on this line of thought.

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