

How Informatization Has Changed the World During the COVID-19 Epidemic

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Abstract: Informatization and the management of epidemics go hand-in-hand. The COVID-19 outbreak has wreaked havoc on both individual health and the global economy. Yet, informatization is changing as altered the tools available for a government response. Informatization shows three common characteristics—an increasing number of information dissemination platforms, the emergence of online services, and big data collection and analysis. This paper contrasts economics entities' variegated reactions to the COVID-19 outbreak with those of previous epidemics due to informatization. Although the epidemic still damages the global economy via pathways such as limiting international transportation, informatization provides economic entities with more means to mitigate the damages and recover quickly: customers use online services to eliminate implicit costs and shift their preferences; firms build customers' loyalty by analysing bit data and change labour demand preferences according to their business demands; governments enact suitable policies like releasing online voucher payments to jumpstart the economy.

1. Introduction

Wuhan, the capital of Hubei province in Central China, experienced a COVID-19 outbreak in the end of December 2019. As of May 2020, over five million people had been infected worldwide, and over ten thousand had died.

Not only does the spread of the virus threaten public health, but it also has adverse effects on global economics and international trade. The global supply chain has been disrupted because of the shutdown of the “world’s factory” i.e., the interruption of production in China. Companies across the world depend upon Chinese production, irrespective of industry or scale. They now face a dilemma. Furthermore, the limitations, and even restrictions, on transportation have slowed global economic growth. While human bodies suffer the physiological effects of the epidemic, global financial markets have also responded to the changes. Subsequently, global stock prices have dropped. For instance, China’s GDP increase rate plunged to 6.5% in the first quarter of 2020, the lowest since China began using standard GDP increase rate measurements. According to the U.S.

Bureau of Labour Statistics, in April, the U.S.'s unemployment rate reached 14.7%, its highest since 1948.

Qi points out the relationship between COVID-19 and humidity, which means that this is a seasonal disease [1]. If humidity were to decrease by 1%, the number of infected people would increase by 6%. This is a major difference between COVID-19 and the 2003 SARS epidemic. Therefore, understanding the disease's economic effect is essential, even before the implementation of interruption methods such as a vaccine.

Epidemics influence macro- and micro-economics, both directly and indirectly. Many studies have found that population health and infant and child mortality are positively correlated with wealth and economic growth [2, 3]. Using models and data, studies have pointed out the immense costs of disease prevention that countries face. For instance, Keogh-Brown et al. argue that measures for preventing infection and decreasing mobility monopolize human and physical resources. Then governments must pick up the tab. They have also built models to point out that decreasing the labour supply decreases production. This alters prices, customer preferences, and habits [4].

Consider HIV/AIDS. The spread of the virus has an immense effect on individuals, companies, and governments by shifting labour supply and efficiency, incurring costs for corporations, and discouraging both domestic and foreign direct investment. Arndt and Lewis use a computable general equilibrium macroeconomics model to show the macroeconomic effect of HIV/AIDS [5]. Like influenza, COVID-19 is far more contagious than HIV/AIDS. A previous paper has shown that the SARS virus had a significant effect on macroeconomics through significant reductions in demand for commodities and services, and an increase in business operation costs. Furthermore, shocks to other countries' economies were transmitted, depending on the degree of the country's exposure to the disease. With constant technological advancement, the global economy suffered immense damage, even though the number of cases was small [6].

A handful of studies have used macroeconomics models to quantify the economic costs of large-scale infectious disease outbreaks. Bloom et al. estimate the potential impact of a pandemic caused by the avian influenza strain through the Oxford economics forecasting mode [7] 1. They predict that a large-scale and long-term outbreak will lead to a GDP loss of 6.5% due to reductions in consumption and exports. Global GDP decreases by 0.6%, and global trade of goods and services declines 14%. McKibbin et al. apply a global intertemporal general equilibrium model with heterogeneous agents. They argue that global GDP will decline from US \$2.4 trillion to US \$9 trillion, depending on the degree of the infectious disease outbreak. Also, in the financial field, equity markets drop due to the rise in risk and the expected economic slowdown. Funds from equity markets tend to shift into bonds, cash, and overseas holdings [8].

Informatization, and especially the internet, has connected individuals around the world. With improvements in technology and the construction of new facilities, people utilize low costs to enjoy the benefits and conveniences of the information era. The effects of informatization can be divided into the following categories.

Firstly, the proliferation of social media platforms has given people with electronic devices the chance to tell their stories without entry barriers. Jacob Amedi shows the benefits of social media platforms, such as breaking cultural and knowledge barriers, enabling individuals to find their common interest-based groups to improve their social identities, and eliminating obstacles to higher goals by the sharing knowledge [9]. However, social media platforms also cause addiction, harming physical health. Additionally, criminal activity is facilitated by sharing knowledge online [10].

Secondly, many existing offline products and services are now online. Also, the development of new products and services has become mainstream in various industries. Online products and

services can both satisfy consumers' needs and reduce costs to increase profits. For example, commercial banks are now imputing a big portion of investment into fintech. Thomas Philippon argues that merging digital innovation with supportable technology-based business models dissolves existing industry structures, changes traditional channels for providing products and services, and makes financial services more accessible and convenient [11]. With the effects of fintech, online products and services are fusing boundaries between fields, creating opportunities for corporate innovation, and enabling more people to enjoy the resulting conveniences.

Finally, there is big data collection and analysis. In the business world, decision-makers, especially intuitive ones, tend to use their intuition and past experience to make judgments about the market. They regard data as evidence and proof for their decisions. Furthermore, the emergence of big data mining, and technological advancement have changed the functions of data from an auxiliary tool to a decisive factor in strategizing. In a report by the Capgemini Consulting Company, two-thirds of respondents said their business strategies and corporate decisions required big data collection and analysis [12]. However, the implications of big data on business processes and systems is difficult to quantify, although it is indeed an essential tool for improving company performance [13, 14]. Economists are also emphasizing big data. It is used to monitor economic conditions to provide a basis for decision-making for market-oriented economies and policies. The accessibility of dynamic data also enables solutions to many problems which were previously unattainable due to data constraints. Big data is also a tool to verify economic models and theories. The background information above demonstrates that the changes brought about by the digital age are reflected in many aspects of people's lives. Therefore, some scholars have regarded big data as a new factor of the production function. By studying whether the intangible assets represented by R & D investment will affect shareholder value, Martin Užík et al. discuss whether the intangible assets can become the fourth factor of production (in addition to labour, land, and capital) They conclude that the intangible assets do not have a definite effect [14].

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2. Economic Entities' Reaction in the Digital Era

Most literature discusses effects of informatization and epidemics on economic entities separately. However, several point out economic entities' reactions and countermeasures to epidemics under the background of informatization.

2.1. The Emergence of Information Dissemination Platforms

Because of informatization, the increase in social media and various short video platforms has provided more individuals with opportunities to disseminate information. It also enables people to track the development of an event through various channels, changing their behaviour according to the new information that is integrated into their individual situations.

As expert media journalists become less common, a large population of "we media" are flooding in, attracting users with professional text and video technology. In addition, some individuals or "we media" platforms fabricate information or publish works to attract attention. For example, when people do not want to buy health insurance, they are more likely to see the "we media" that release negative information about health insurance, which will attract more "we media" to follow suit. However, this will make people more conservative and rigid in their comfort zones. Governments and international organizations also use information disseminating platforms to

update guidelines and information to guide behaviour. At the same time, to reduce public panic and protect citizens' health and property, relevant departments and international organizations upload official data and report protection measures. Governments have also implemented targeted policies in response to the COVID-19 outbreak. For instance, when the outbreak began, the Chinese government utilized public service announcements to promote protective measures such as wearing masks, and disinfection measures. This was done through both official news media, and social networking platforms. They also used apps like WeChat and Alipay to implement health codes to monitor citizens' movements.

With the help of information disseminating platforms, each economic subject can track relevant information on the issues they care about, reducing information asymmetry and thus making decisions in line with their own interests. In the past, most public information came from official publicity broadcasts, leading their understanding to remain within the official narrative without affecting their emotions and lives. The widespread dissemination of information shifts understandings of events from official texts to real integration, generating mutual sympathy. This urges people to change their behaviour. For example, in the early stages of information technology development, people would provide assistance through official publicity messages. Meanwhile, the proliferation of social media platforms has made more individuals, and even low-income groups such as elderly nursing home residents, voluntarily sacrifice their consumption to assist outbreak areas. At the same time, the increase in information dissemination platforms prevents the worsening of the epidemic and the loss of government credibility, caused by local government underreporting. In the early stages of the COVID-19 outbreak, local government officials in China delayed the best prevention and control measures. This was because they were afraid that exposing the epidemic would affect their political performance, resulting in the loss of many people's lives and safety, and the loss of the government credibility in the minds of citizens. The Central government could prevent further losses due epidemics by capturing grassroots and public information released from social media platforms and conducting timely local assessments and investigation. Wuhan, the epicentre of the COVID-19 outbreak, concealed the epidemic in the early stages. Later, users and media on Weibo, a popular social networking platform in China, revealed that the Hubei Provincial Government had held a political event, and had not given timely feedback on the epidemic. China's Central government conducted a special investigation, and ultimately disclosed the findings to the public. It investigated the officials in charge, rebuilding citizens' trust in the government, and laying a foundation for citizens to cooperate with future government policy.

2.2. The Evolution of Online Products and Services

The emergence and widespread application of technology has moved various services online. This has laid the foundation for controlling the epidemic and ensuring safety. Due to the COVID-19 outbreak, China's Central government has delayed the resumption of work and imposed a strict quarantine, thus preventing in-person work, education, and transactions. Fortunately, online platforms can ensure that people meet their needs and maintain their health through websites or mobile apps. For example, online communication tools such as Zoom, and Tencent Conference provide communication avenues crossing wide distances. During the present epidemic, international governing bodies and medical institutions have had a more comprehensive and rapid understanding of the event's progress. As such, they enact countermeasures with online communication tools to curb its negative effects. Furthermore, online learning tools such as Ding Talk and Blackboard allow students to study, submit homework, and take exams. They also facilitate teachers' evaluation of students' learning progress and achievements. At the same time, many companies offering online

products and services, such as the game industry, have taken this opportunity to attract users and cultivate loyalty. This lays a foundation for growth and development after the epidemic.

2.3. Big Data Collection and Analysis

In the digital era, the collection and analysis of big data are constantly evolving. Big data can help companies analyse the behaviour characteristics of populations or users in order to improve their strategies for achieving their original goals. With broad collection scopes and long time spans, seemingly disordered data can also be transformed into the “order, correlation and stability” law of group behaviour [16]. In particular, after analysing data collection corpora, policymakers and CEOs can strategize according to characteristics of their citizens or user groups. They can also adjust strategy according to the results of new data analysis. In the field of business, people will shift emphasis from offline to online services, providing online business with opportunities to collect consumer data. For example, social media platforms like TikTok can detect users’ viewing preferences through their browsing records in order to push relevant information to them. Also, suitable products and services are recommended to users by remembering their past usage records and current situations. Food companies can extract consumer preferences from vast amounts of data, such as their preferences for packaging and flavours, after the analysing corpora of data, and building strategies to establish brand awareness.

The public dissemination of big data can consolidate wisdom, attracting individuals to discuss and improve government policies. Additionally, the quantified effects of policies can be observed, laying a foundation for broader promotion in the future. With the increasing penetration of the Internet, individuals have more access to information than ever. Thus, by releasing data and information, governments can allow their publics to feel the effects of policy. Accordingly, the policy can be evaluated from different angles to improve it. Intuitive feeling also facilitates policy implementation in a broader context. In the case of COVID-19, data collection and analysis have helped the Chinese government mitigate the damage caused by the epidemic. The Chinese government has used the popular apps WeChat and Alipay to create a health code program that collects information about people’s activities and movement. This enables them to identify where infected patients have been, analyse their routes, and find out who has had close contact with them. These measures mitigate the risks of spreading the virus, and the costs of large-scale searches for potential infected people. At the same time, the Chinese government has released data about the outbreak via its website, stimulating public discussion. Citizens also have the chance to voice their opinions and suggestions on social media platforms. This improves their understanding of the policy and assists the government in improving it as well. Also, it can inspire scholars who are drafting policy proposals on various topics such as preventing and controlling the spread of viruses, and economic restimulation.

3. Discussion

This chapter has summarized the prevention and control measures, as well as the responses, of various economic entities under the three typical characteristics of informatization. Related articles have discussed the potential effects of the epidemic on the macroeconomy from the perspectives of declining personal consumption and demand for services, the shrinking labor supply, increasing operational costs for companies and national exports. However, few articles have discussed the influence and function of informatization during epidemics. This paper argues that informatization will weaken the effect of epidemics on economic entities. In turn, the emergence of the epidemic

itself will promote the informatization of economic activities. This will be described from the perspective of individuals, firms, and governments.

3.1. Consumers

The economic effect of epidemics is first manifested on the demand side. Due to epidemics, consumers must pay higher implicit costs. This is due to both protection measures and the threat of infection. Thus, additional transaction costs will be factored into their consumption decisions. According to the tax wedge model, as consumer demand for goods and services decreases due to epidemics, producers cut supply. Therefore, the original equilibrium point between price and quantity shifts to the left. The gap in pricing between the demand and supply sides is the additional transaction cost generated by consumers for goods. Therefore, with informatization, offline transactions are transitioned online to reduce the risk of infection and additional transaction costs. According to a report by the Big Data Research Institute of Kuaishou, sales on live streaming videos rose 76% from February to May on one of the most popular short video sharing platforms in China.

The convenience of information transmission and sharing channels enables consumers to make better spending choices. Since the COVID-19 outbreak began, individual health awareness has transitioned from fitness regimens to emergency disease prevention. This has led to an increase in the consumption of products and services related to healthcare and nutrition. Meanwhile, as incomes fall and mobility is constrained, demand for goods with high demand elasticity, such as luxury goods, falls. However, some information outlets publish distorted reports, or even fabricate information. Thus, people tend to hoard products or services, leading to market confusion. For example, after COVID-19 broke out in India, there was a rumour that cow urine could prevent it. Consumer demand for products containing this ingredient spiked. Coincidentally, the demand for iodized salt increased after the Fukushima nuclear power plant leak in Japan. As a result, the rise of information dissemination platforms has increased governments' resource costs for fighting rumours and misinformation.

3.2. Firms

With consumers needs and technological advancement, the online services provided by the service industry will expand, and the new generation of products will diversify. Therefore, the demand for high-tech professionals such as coders increases in order to maintain and meet market demand for products and services, both new and existing. Specialized professionals will be attracted by high wages and preferential treatment. At the same time, both the cost and the demand for offline employees will drop. At present, Internet companies with mature informatization programs need more talent in the field of development than they do in algorithms. This shows their consolidation of existing products and services. Therefore, further innovation to expand market share requires artificial intelligence and big data to analyse consumer needs and desires. Furthermore, the industry's demand orientation will be reflected in the education field, in that students will gravitate toward high-tech majors. Also, schools will have higher budget expenditures. Each of these factors will increase employment pressure for students who prefer arts and humanities majors. Moreover, layoffs will redistribute human capital between industries. During the epidemic, the manufacturing industry was forced to shut down and cut production due to reduced demand. To reduce costs, layoffs were implemented. At the same time, some service industries, such as delivery services, are

in urgent need of labour to service frequent online activities. Therefore, human capital from the secondary industries will flow to the tertiary industries.

It is worth noting that many companies over-emphasize growing user counts and their online platforms' exposure, while ignoring the quality of products and services and their business models. As a result, a large amount of capital investment does not transfer into comparable business value. Therefore, while promoting online products and services, companies are also supposed to maintain and strengthen their platforms' offline capabilities and their business models, while maintaining high-quality supply chains.

3.3. Governments

As the world's second-largest economy and the "world factory" of global manufacturing, China's economic importance cannot be ignored on the world stage. China has mounted an unprecedented economic response to an unprecedented epidemic. From the perspective of policy implementation and publicity, China has made great efforts to develop its street stall and small-shop economy, hoping to achieve the economic goal of ensuring people's livelihood and stable employment by creating low-cost independent businesses. The network of consumer behaviour has already become mainstream in the market economy.

With the proliferation of online payments and e-commerce, the online shopping consumer base continues to expand. To expand domestic demand and promote consumption to realize economic recovery, the Chinese government has issued vouchers through electronic platforms in several cities such as Beijing and Nanjing. The issuance of e-consumer coupons will help the supply and demand return to the equilibrium point from before the epidemic. This can offset the implicit costs caused by fear, as well as the measures taken to control the epidemic and grow demand. On the supply side, the renewed increase in demand will promote the reopening of production lines, and the gradual return to pre-epidemic sales. Macro-Policy Research Group, led by Liu Qiao of the Guanghua School of Management at Peking University, says in its "Package of Policy Suggestions for China's Economic Recovery after the Epidemic" that the Chinese government should use a "two-tier" consumption incentive plan, in which 900 billion yuan of consumption vouchers will be distributed nationwide to promote economic recovery.

However, not all industries can provide services and goods through online platforms. Examples include tourism, civil aviation, and hairdressing. These services, which are likely to bring people into close physical contact, will still raise expectation values in consumers' minds. Therefore, helping these industries recover will require governments to use policy tools like financial subsidies and cooperation with Internet companies to establish special platforms.

4. Conclusions

This article has discussed the effects of informatization on the economy during the COVID-19 epidemic. It is inevitable that international trade will be impacted by the epidemic. However, information dissemination platforms, online products and services, and big data collection each provide channels for analysis and influence. This can mitigate the economic effects of the epidemic and facilitate a return to normal economic life. This is unlike previous large-scale outbreaks. Based on three characteristics, this paper has discussed the epidemic's effects on consumers, companies, and governments, both empirically and theoretically. At present, due to the spread and recurrence of COVID-19, and the difficulty entailed in developing a vaccine under time constraints, governments around the world have gradually reached a consensus, or even made changes in their government

documents, to address normalization after the epidemic. Therefore, by reducing the epidemic's effect on real economic life, informatization can mitigate its damage. Future studies could verify and supplement the viewpoints presented in this paper by using empirical data, especially consumer data. In addition, the outbreak of epidemics will promote further informatization, and exert far-reaching effects on future consumer behaviour, business models, and governance.

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