

How Digital Economy affect Innovation? Evidence from Commodity Quality and Green Economy

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Abstract. The concept of digital economy is spreading quickly as human has entered the information age. Digital economy contains a wide range of things for anything relating to using digital data either directly or indirectly to lead the production of aggregation effects of resources, which starts a whole profound revolution of society and economy. This paper will discuss about the innovation in the development of digital economy, focusing on innovation effect, purchase quality and green development. Some limitations might be found in the process of research due to some non-linear linkages in certain economic relationships and some difficulties in the technology of model designs. For the policy used in the whole digital economy and digital reform, it is necessary for it to better analyze the local economic model, activate the consumer market, and drive the growth of the entire consumer.

Keywords: Digital Economy; Innovation; Purchase Quality; Green Development.

1. Introduction and Literature Review

Digital economy derived from developed countries such as America, Japan, German (Sugito & Saragih, 2020). Its most initial form is internet economy. In general, it brings digitization technology, goods and services into human economy active area in a comprehensive, multi-layered, accelerated way. Its feature of essence embodied in the accelerate development of informatization, which means that information industrialization and industry informatization are mutually reinforcing and effecting (Zhu et al., 2021).

As the mobile internet and internet of things develops, the interconnection between people and people, people and things, and things and things are able to achieve. Meanwhile the amount of data increases at dramatic rate. The accelerating rate of global data fit the Moore's law for big data, doubling the size at an interval of approximately two years. Large number of data and its management and application requirements hasten the big data concept. Data is becoming an important strategic resources. Data resources will be the new core competence for enterprise for the one who held more data has more advantages (Clohessy & Acton, 2019).

Since digital economy is relatively new, there will be difference in the mode of economy in different countries under different economic environment background. A relatively obvious difference between the attitude towards the information flow is that comparing to American and Europe's support of information export, China has set certain amount of limitations on the output and input of information. A typical case is that China citizens are prohibited to use apps like google. However, it is no doubt that America, Europe and China will continue to set policies to encourage the development of digital economy.

Digital economy has already been used in a large number of succeeded cases.

The improved commodity quality is a specific points that digital economy focused on. For instance, the effects was shown in the glass fiber cloth intelligent inspection system of China Hangzhou Guochen robot technology limited company. For chemical fiber enterprises, the quality of glass fiber decides its standard and price. If there is blemish on the surface then the cloth price will usually decrease for about 45% to 60%. The Guochen robot, depending on its robot vision and its deep learning, produced glass cloth intelligence examination system that assess the quality of the glass cloth.

It works along with the field equipment and changes its scanning frequency according to the production line speed. It not only ensures real-time performance, but also authenticity of the collected

image. It provides guarantee for the accurate detection of various defects such as small loose yarn, warping, black spots, water stains, etc. In this way, the complete implementation process is stable regardless of the change of application scenarios, improving the glass cloth quality effectively while lowering the learning costs (Internet weekly., 2022).

Digital economy has also made a great efforts in promoting green economy. It achieves this in combining itself with several different industries: First, the combination of digital economy and 5G technology is used in current telecommunications infrastructures, which are becoming intelligent network and service platforms (Knieps & Reynolds, 2021). This can improve the network system of environment supervision and pollution disposal; Second, the combination of digital economy and AI technology is also applied in task automation by making context-specific responses that are beyond their initial programming by humans (Nuechterlein & Weiser, 2007). Garbage classification intelligent robot is one of the products. Third, the combination of digital economy and Internet of Things (IOT) is implemented in capturing, analyzing and transmitting the receiving data(Rose, Eldridge, & Chapin, 2015). This helps to discover the problems of pollution source and respond related information to the network. With this strengthening and powerful technology to detect and respond the problems of pollution, although the digital economy mode is not mature and its basic infrastructure work has a lot to improve, there is a very large potential to create green economy innovation when it is brought into the industry of environment protection.

Admittedly, what we know of how digital economy can benefit us is still not enough. Digital economy has only been created and developed for a few years and evidence and practical cases of its achievements is limited. Available researches of how digital economy achieves the upgrade of commodity is single at present, and the effects are bounded in the stronger ability to detect flaw. Moreover, how digital economy bring good to environment protection is still based on the theory and prediction to a large extent. So there is a lack of evidence in explaining the ways it affects the environment and supervision system. In addition, investigation has always been focused on a single area which resulted in the lack of comparison among different countries and regions in explaining the development of digital economy.

In light of these facts, first, this paper aims to analyse how digital economy achieves the upgrade of commodity quality in details and in different aspects and industries. Moreover, it also investigate the ways it affects the environment and supervision system and how it develops in green economy. Last but not least, the paper will also find the difference of the development of digital economy in developed and developing countries. Evidence, researches, theories and many practical cases will be provided in the paper to help to interpret.

2. Methodology

Three methods will be used in this paper to discuss about different aspects of the development of digital economy.

The first one is the case study means in which we use the development of digital economy in three specific and representative countries as the case study.

The second one is the literature Review Method means by which we conclude and analyze the existing development trend and defects of the literature in digital economy.

The third one is the comparative study means. We compare China, America and Russia to distinguish how their differences will be in digital economy, especially from the perspective of commodity quality and green economy.

3. Result

3.1 The comparison of digital economy among America, Russia and China

The paper first analyzes the condition by using case study method. Three countries——America, Russia and China will be chosen to consider.

First, America, act as the cradle land of digital economy, continue to lead the digital economy development in the world. The core competitiveness of digital economy to America is its ability to conduct independent innovation. It means that the national group itself, instead of depending on external help, through completing a large number of research, breakthrough the upper limit of digital technology. American mode of independent innovation is largely depending on its mature technology of integrated circuits, artificial intelligence, high-end chips and etc. Since America grasp these advantages in developing digital economy, it see digital technology as its main competitive power.

In 2020, American proportion of digital economy was 60%. America established certain regulations on supervision and punish in digital economy. In 2020, America California has passed the 《California Consumer Privacy Act》 to solve the problem of exposure of personal data. American government also signed the 《Transparent and open government memorandum》 to encourage people to discover and solve the potential problem via digging the data information.

America attach importance to the establishment of information basic infrastructure. Early in Clinton administration, America has focused its developing direction on two aspects: cloud computing and 5G technology, and published the 《U.S. Government Cloud Computing Technology Roadmap》 in 2014 to support the newly digital companies. It is also found that American's digital economy development rely on the help of national defense technology department and the purchase of government.

For Example, iPhone developed by apple company involves the technology of internet, GPS and Siri which was the strategic results of American national defense department after decades of investigation. At present, American enhance the education of digital talents and remain its place at dominating the rules of global digital trade (Beaumier et al., 2020).

Second, Russia, as there is already a certain number of countries leading the development of digital economy, also began to put its attention to digital economy and see it as a long term national strategy. It hopes to get rid of its dependence on natural resources by digital transformation. Russia digital economy developed at a very fast rate during the past few years, for 25% of its GDP increase in 2019 was due to the digital economy innovation. Russia highly regarded the digital governance.

The development of digital economy in Russia involves the use of information and communication technologies in many different sectors like households, industrial firms and other services. This contributes to the formation of conditions for the acquisition of specific competencies by the population and enterprises and allows maximizing the benefits from the spread of ICT (Karieva & Akhmetshina,2020).

In all of the fields of digital economy, Russia showed its high digital governance ability in smart cities and E-government. In the aspects of smart cities, Russia became one of the world leaders in the level of city infrastructure digital application. According to the rank of Sweden IT company Easypark, Moscow was 77 in a total of 500 world smart cities. For the aspects of E-governance, Russia founded the Federal National Information System and Russia citizens' level of satisfaction towards receiving national services by using E-governance system was relatively high. Russia performed well in maintaining network society.

In 2020, among 193 countries, Russia's cybersecurity index ranked number 5, which was located in the first echelon. However, Russia still has a lot to improve in the area of digital basic infrastructure establishment, digital technology development, ICT industry development. In general, Russia's economy structure is unreasonable for it depends too much on natural resources. What's worse is that Russia's population is decreasing continuously which causes a lack of labor force. New digital economy can alter the traditional trade mode and there is potential in the innovation of digital economy to improve the economy structure (Gureev, Degtyareva, & Prokhorova, 2020).

Third, in China, digital economy is also improving at a dramatic rate. The overall scale of the economy increased from 18.6 trillion yuan to 35.8 trillion yuan between 2015 and 2019, a total increase of 92.4%. The feature of big scale of digital economy, its fast developing rate together with its important position in national economy made digital economy the core power to push China

economic growth. Digital economy is effective in opening the domestic circulation, boosting the domestic demand and promoting the consumption.

Take Pinduoduo, a new e-commerce platform, as an example. It succeeded in stimulating the domestic demand by using low prices to target China's large number of long-neglected cities and towns, and use internet platforms like WeChat to increase users' stickiness. In the era of digital economy, because of network effects, large scale of China population became the base and advantage of digital economy development. Digital economy also helps the digital governance of government.

During the epidemic of Covid-19, in order to promote consumption, China government sent many consumption vouchers to people through living platforms such as Alipay and Meituan. However, there are also many problems appeared during the digital economy development. For there exists regional imbalances in the development of digital economy. This is due to different regional resources and industrial structure. Development of digital economy requires digital talents knowledge and technology, developed cities tend to equip with more talented people and digital technology. So innovations are usually found in developed cities (Sidorov & Senchenko, 2020).

Another feature of China digital economy is its concentration on manufacturing sector. Goods of manufacturing production like computers took a proportion of about 55 percent of total value added in China's ICT sector. As for the service, it only occupy 45percent in China's ICT sector. So it is easy to see that even in the background of digital economy, China is still deeply rooted in manufacturing (Garcia & Xu, 2018).

Comparing the three countries, America is the most advanced leader in digital economy innovation and services is its dominating department. In 2019, global digital economy scale was 31.8 trillion dollars while America's digital economy scale was 13.1 trillion dollars which located at the very first place. China's digital economy scale was 5.2 trillion dollars. China has a long way to go in digital economy compared with America especially in the field of services (Belitski et al., 2022). But compared with Russia, the comprehensive strength of Chinese digital economy is slightly inferior. But Russia managed better in digital infrastructure and digital developing environment than China (Ji, Jiao & Cheng, 2023). Meanwhile, China needs to improve the independent innovation ability and national science & technology in digital economy.

3.2 The comparison of Commodity Quality among America, Russia and China

Digital economy can also improve the commodity quality through various methods. Firstly, digital economy rely on information, internet, data and etc. These are mixed with social economic activities and formed a large number of new industry forms and new business modes. Technology developed in digital economy helped to automate the producing devices so that the producing process can be perfected. Moreover, better equipment also enhance the ability to conserve and use the data and strengthen the effectiveness of the information it gained. All of these methods improve the cooperation among the purchase, production and management of the enterprise, raising the efficiency of the whole producing system.

Chinese economy, under the background of this new era, has turned to the stage of sustainable development. A policy called "The 14th five-year plan" pointed out that China should promote the digital development, improve the commodity structure and methods of trade, which could continuously improve the quality of exports (The National Development and Reform Commission of the People's Republic of China, 2022).

Taking an event of Alibaba as an example, a shop in Cixi city selling kitchen tools on Taobao was randomly selected to be checked. It is reported that the quality of its product the compression release valve is not satisfied. This information was submitted to Alibaba platform. The products are banned by the platform as a result. It is known that compression release valve is a traditional manufacturing product of Cixi city, where is the main manufacturing area of this product. It is calculated that there are 170 firms selling compression release valve related products. However, the quality of product could not pass the standard for a long time and this seriously affected the credit of quality produced by Cixi city. In order to change the situation, Cixi supervision department reacted actively and signed

an agreement with Alibaba to jointly promote high-level supervision and improve the quality of online goods. The two sides rely on digital platforms. Through the promotion of smart regulation the quality of the compression release valve was obviously improved (China Consumption Official Website, 2021).

As for Russia, the quality management of product has already established in Soviet era. Business leaders from Russia are faced with complex domestic changes, competitive forces from international markets, and problems of low quality product (Sinkovics & Ghauri, 2008). Large number of various authors have carried out a lots of studies of Russia business managers and found that Russian management culture is characterized by high power distance, low tolerance to uncertainty, and high appreciation for collectivism (Khilkhanov, 2012). A system called total quality management play an important role in the operation of Russia companies in both the domestic and global markets.

In order to solve the problem of low quality products, Russian enterprises have to prepare their workforce to face changes and new challenges; creating a strong focus on costumer driven goals; introducing flexibility and innovation. But most importantly, the traditional modes for the business to control their products quality have to be changed and the conformance to total quality implementation have to be maintained at every level of an organization.

There are several main factors which can improve the total quality implementation in Russian companies. First is that entrepreneurs have to be more familiar with modern methods. Secondly, not only the quality of the products has to be improved, the producing process also need to reach a higher quality level. Third, an more effective inventory management should be implemented. The last one is to introduce a greater flexibility in production systems (Khoo,2002).

Thus, we can conclude that Russia need to develop a more modern methods and advanced technology in its management system and producing process to improve the production quality. Combining with the new global trend of digital economy, it is no doubt that advanced technology like digital technology is vital to be used in the total quality implementation applied to the production of goods and services in Russia companies.

In American economy, under the strong development of digital economy, many goods and services provided appeared to be innovative and efficient. For example, the products of maize, which United States occupied more than 40% of the international maize market, have a great impact on international maize market. Maize in America are divided into 5 grades according to different indicators that indicate various data and calculation(Zhang et al., 2017). Such data information calculated need a data supervision system to conserve. In addition, if the data is conserved in a fine way, then it is easier to observe the abnormality when problems appear with the maize.

The latest AI invention found in America called ChatGPT also shows its effects in producing. Firstly, ChatGPT equipped with a various language system so that users from different countries are able to enjoy the services, raising the satisfaction of the consumers. Secondly, ChatGPT can enlarge its scale of users due to its powerful information detecting function. That is, users no longer have to search their question and find the answer by themselves. Instead, during the conversation with ChatGPT, the best information scanning outcome is directly submitted to the consumers, improving the efficiency of the service. Thirdly, ChatGPT has a wonderful function of knowledge servicing. It includes all kind of internet, e-books, news articles, electrical email, etc. With all these knowledge it can even complete a college student's homework. Meanwhile, it offers the users a wider range of information and a stronger knowledge service ability (China Social Science Internet, 2023).

In general, America has mixed its technology in digital economy with the production of goods and services in an innovative way that any other countries have never done before. America is the main engine that drives the use of digital technology into the production and has been continue to lead the world in doing this since it first brought digital technology into the era. China has done great in using the digital economy in manufacturing department but still has a lot to improve comparing with America. Russia is still finding its own business management mode under the potential use of digital economy.

3.3 The comparison of Green Economy among America, Russia and China

A green economy, currently, is identified with the reduction in consumption of the energy from traditional energy sources, energy and resource efficiency, and growth of the share of energy from renewable sources(Szyja, 2016). Digital economy create new ways of protecting the environment. By deeply mixing the digital technology and digital methods with work of environment protection, the smart and efficient environment management information system can be established, providing strong support for the level and ability of environment protection (People's Information Internet).

In United States, on January 8th 2009 President Obama announced "The American Recovery and Reinvestment Act" in which nearly 80 billion dollars was distributed to projects related to clean energy. In addition to the financial support, other actions have been taken also. For example, introducing new requirements for car models produced during 2012 to 2016. Setting measure for heavy truck models in between 2014 and 2018. However, one of the factors affecting green economy that is relatively new is the introduction of structural changes in the economy. It means introducing ecological transformation of traditional sectors. In United States the government made state's assistance for General Motors and Chrysler subject to, among other conditions, the introduction of efficiency technologies in production processes and adding environmental-friendly vehicles to their offer(Mearsheimer, 2021).

Moreover, in recent years, US government continue to suggest carbon neutralizing relating policies. In 2020, America propose the zero carbon emission action plan, founding clean energy economy. In 2022, The Clean Competition Act was proposed to levy taxes on carbon emissions. This dual carbon goal related to digital economy to a large extent. The United States has relied on the promotion of a large number of mandatory measures and the attraction of preferential policies to achieve the rapid development of the digital economy by restricting and encouraging the two-pronged approach, while escorting the realization of the dual carbon goals. The federal and local governments enforce the implementation of policies by setting up regulatory agencies and executive organizations. And it also encourage enterprises to save energy and reduce emissions by formulating preferential and stimulating policies, so that new and renewable energy can be promoted and used on a large scale.

On top of that, the United States pay attention to the investment in new technology to reduce costs and increase efficiency. At the beginning of the 21st century, the United States realized the transformation from industrialization to informatization, which further brought about the continuous reduction of national energy consumption. Relying on the advantages of cost reduction and efficiency increase brought by informatization, the United States continues to accelerate its industrialization process, achieve carbon peaking, and move closer to carbon neutrality. The emergence of new technologies in the era of digital economy provides key support for the realization of the dual carbon goal, provides important technical support for emission reduction on the supply side, promotes industrial intensive development by improving work efficiency, reducing production costs, and reducing energy consumption and input. On the demand side, relying on new technologies to improve consumption, investment and other habits, reversely promote the transformation and upgrading of the supply side (Lin & Ma, 2022).

In China, although the economy experienced a rapid growth after the reform and opening up, all kinds of environmental problems are becoming prominent. However, under the rise of the digital economy, the huge digital consumer market and the gradually improved Internet infrastructure, as well as feasible policies, have become favorable supports for the green economic growth. The digital economy provides high-quality technical resource support for many fields of life, increasing the sustainability of universities, the upgrading of industrial structure, empowering the circular economy, and commercial digitization with household consumption. This are able to accelerate the development of emerging industries, improves industrial green production efficiency, and promotes green economic transformation (Liu & Bashir, 2021).

Admittedly, China's total environmental pollutants emissions are high with 1.0357 billion tons of carbon dioxide released per year, exceeding the environmental capacity and resulting in increasingly serious environmental pollution. In a word, this rapid economic growth of China is actually at the

expense of the environment, which is contrary to the concept of coordinated economic and environmental development advocated by China.

In recent years, the communist party and the government of China have issued a series of environmental protection policies. For example, the 18th national congress of the communist party of China issued the Overall Plan for the Reform of Ecological Civilization System; the 13th Five-Year Plan for Ecological environment Protection issued in 2016 (Zhang et al., 2022).

At present, the development model of China's digital economy to promote the realization of the dual carbon goal can be summarized as "the two-wheel drive of government and market to promote green transformation, and focus on improving the level of technology". The government formulates scientific decisions based on the goals and actual conditions in the system design, and supervises and controls the dual carbon risks in development. The market provides space for technological innovation. Here are three main points that have to be paid attention.

First, Chinese governments rely on digital technology to strengthen supervision and improve environmental protection and energy efficiency. Digital technology plays a vital role in the supervision and trend forecast of carbon emissions. And the planning of overall carbon emissions in the energy industry helps to reduce carbon emissions in the energy industry, improving energy efficiency through supervision and forecast.

Second, Chinese governments increase efforts to encourage the use of clean energy. Through the integration of energy technology and information technology, China continuously optimizes the energy structure and achieve the purpose of energy conservation and emission reduction.

Third, Chinese governments strengthen policy guidance and top-level support. By designing relevant encouragement and regulatory policies for the development of the digital economy, the digital economy department combines incentive policy with evaluation and supervision systems. Hence, relevant policies become an important driving force for energy conservation, carbon reduction of enterprise entities, and the main support for green digital transformation, which helps the "dual carbon" process in the whole Chinese society (Spitsin et al., 2020).

As for Russia, the trend of a greener economy has aroused a heated controversy especially in north area where the resources extraction takes place (Korchagina et al., 2020). At present, the largest part of Russia is not used appropriately to create profit for the local since a large number of people is keen to live in the big cities because they can enjoy better infrastructure and employment opportunities . However, there are increasing people who cannot bear the densely cities and want to find a less populated area with a better environment (Aleksandrov et al., 2019).

In Russia, the need for the introduction and development of green technology was noted in March 2012 in the report "Strategy 2020 : A new growth model-new social policy." The report emphasized that federal policy in the field of green development should be aimed at the strategy for green growth through integrating the socio-economy and environmental development in the form of green economy (Karieva, Akhmetshina & Mottaeva, 2020).

In the area of gas and oil sectors, the weak point of these sectors in Russia is the technology development. According to the 2018 data, the proportion of oil and gas business that carried out technological innovation averaged 8-10%. Moreover, those environmental effects from man-made accidents and disasters were not taken into account.

Thus, Russia government strategies for changing the situation mainly relied on the technological development of companies. Firstly, the trend of investment in green oli and gas production technologies was steady until 2019 when covid-19 first spreaded across the world. Amd after a slowdown of industrial growth of global economy, such investment has somewhat been subsided. Considering the structure of green investment priorities, the main interest of gas companies lies in the implementation of new technology for geological exploration. In the second place is the use of the digital technologies to improve the operation efficiency of gas business-\$1610.8 million, while in the third place is the digital technologies to monitor well condition, timely trouble shooting and accident prevention-\$1491.0million (Lytras et al., 2020).

Comparing the three countries, all of them has proposed new policies and regulations on fund and economy structure to promote the technology innovation in the direction of digitalization, strengthening the supervision system and automating the producing process. The policies of America and China similar in reducing the dual-carbon emissions. Russia has paid much of its attention on the field of gas and oil departments both in the producing process and in the outcome of damage.

4. Conclusion and Discussion

This paper presents the digitalization process and present development of digital economy in US, Russia, and China; compares the digital development in each of the three countries; analyzes the effects that different digital economy developments in the three countries have on the quality of their products respectively; and discusses about the way how the development of digital economy can drive the formation of green economy and improve the environment at the same time.

Digital economy is first originated in America and is continuously led by America at present. China and Russia were inevitably affected by the trend of digital development and began to improve their own digital technologies. Digital technologies were used in different aspects according to the shortages and situations each country have. For example, Russia would like to use it to change their dependence on oil and gas and is exploring new production methods in both of these sectors. While a large amount of online manufacturing stores began to enter the online trading platforms in China through which we can see that digital technologies are mainly used in manufacturing in China.

All the three countries used the digital technologies to improve the quality of their products successfully by enhancing the monitoring platform and increasing the efficiency of the process to reach a decrease in cost. However, different from China and Russia, on the base of an improvement in the goods and services, America has extended its service function to a new level-information knowledge service platform, a technology leading the whole world.

Digital technologies have also made a progress in green economy in the three countries. America made efforts in using clean energy and reconstructed the structure model of car use. Meanwhile, it also encouraged enterprises to reduce carbon emissions and use cleaner energy. China used informationalized monitoring platform to check on the environment conditions and proposed policies and benefits for companies to use cleaner energy. Russia has done it by investing the enterprises to encourage technological innovation so as to alter the normal regulation and production system.

Overall, digital technologies simplified a large number of complex steps and process by forming a more automatic system. This effectively reduces the costs and time of production, leading people to a higher living standard.

And to maintain a stable development of digital economy, the policy should includes four main points. First is to consolidate the foundation and accelerate the construction of information infrastructure. Second is to improve internal strength and strive to promote the innovative development of the digital economy. Third, make sure that firms continue to improve their quality, expand capacity, and strive to promote the growth of the digital industry. Finally is to encourage the cross-border integration and efforts to accelerate industrial digital transformation.

The limitations of this paper is that there is a lack of data presented and some aspects analyzed may not be comprehensive enough, Since some disadvantages may also present in the development of the digital economy. Hence, this paper could be a starting point to further analyze the development of digital economy in a broader sense to achieve the sustainable goals of different development and transformation modes in various regions and countries.

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