A Study of the Impact of Artificial Intelligence Such As ChatGPT on the Total Factor Productivity of Firms

Xintong Lian[1,*]

[1]Shanghai Yichuan High School, Shanghai, 200065, China

*Corresponding author. Email: 1690610099@qq.com

Abstract. Artificial Intelligence, as an important component of enterprise digital economy, is a key kinetic energy for enterprises to enhance total factor productivity and realize high-quality development. And the widespread use of the new AI ChatGPT marks a new milestone for AI. Based on the existing theories, this paper mainly analyzes the impact of the application of ChatGPT on the technical efficiency, allocation efficiency and scale efficiency of enterprises, and further explores the impact of ChatGPT on the total factor productivity of enterprises. The study found that ChatGPT promotes the development of technology within the enterprise through its collection and analysis of natural language processing technology and data, thereby reducing costs, maximizing the use of resources, controlling the size of the enterprise, and achieving optimal production scope. It has a positive effect on the technical efficiency, allocation efficiency, and scale efficiency of the enterprise, helping the enterprise to improve total factor productivity and gain competitive advantage.

Keywords: ChatGPT, Artificial Intelligence, Total Productivity Factor, Digital Economy

1 Introduction

Artificial Intelligence (AI) is a discipline that studies how machines can be made to exhibit intelligent behavior. The development of Artificial Intelligence can be traced

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back to the 1950s, and has gone through several important stages and breakthroughs, such as logical reasoning, machine learning, deep learning, etc.2022 On November 30, 2022, the American Artificial Intelligence Company released a new type of Artificial Intelligence, ChatGPT, and gained a large number of users around the world in a short period of time. Compared to traditional AI, ChatGPT can carry out continuous conversations with humans, and is capable of more complex tasks such as report drafting, poetry writing, and code writing. With efficient iterative training on over 1 trillion human words and 170 billion model parameters, ChatGPT has a strong ability to learn, reason and summarize itself, marking the emerging fast track of AI technology application.

Total Productivity Factor (TFP), which is determined by factors such as technological innovation, technical efficiency, scale efficiency and allocative efficiency, is at the heart of high-quality economic growth. As an important concept in economics, the total factor productivity of an enterprise measures the impact of technological progress on production. It refers to the efficiency of productive activities over a given period of time and is mainly used to express the partial contribution of output that cannot be explained by the growth of capital and labor factors.

Digital economy can alleviate information asymmetry by reducing enterprise management costs, increasing enterprise human capital investment and reducing enterprise transaction costs, thus promoting enterprise total factor productivity [1]. Wang Dongmei, Sun Yangyang through the entropy method of measuring the city's digital economy development index and listed company data, research concluded that the digital economy on the enterprise total factor productivity has a significant role in promoting, and this conclusion in the consideration of endogeneity issues and a series of robustness test still holds, the enterprise through the realization of product research and development of all aspects of accelerated digital transformation, for improving the enterprise technical efficiency, scale efficiency has a key role in promoting the total factor productivity. efficiency, thus promoting total factor productivity [2]. And ChatGPT gives new value to the data elements of the digital economy. By effectively shortening the process of data resourcing, it makes the search and mining of data relatively more efficient. At the same time, ChatGPT can reduce the threshold of the use of data elements by all subjects of the digital economy, so that more people can utilize data elements [3].

However, the digital economy is not perfect, and there is still a deviation from the optimization approach. According to Sun Zao and Hou Yulin's point of view, in today 's cost-rising industries, companies have enough motivation to widely promote the use of ChatGPT to reduce costs and seek technological transformation. And it is worth noting that AI may also ignore some unstructured information and details while implementing algorithms using big data, so machine decisions are not always accurate and comprehensive [4].

Taking an overview of the existing literature, at the emerging stage of ChatGPT, studying the extent of its impact on the technical efficiency, allocation efficiency, and scale efficiency of enterprises can help the government to formulate relevant policies and play a guiding role for the strategic deployment of enterprises in the real economy, so that they can strictly play a leading role in the supply chain to promote the digital transformation and upgrading, and to strengthen and promote the digital transformation of the upstream and dowproductivity factor. Next, this paper will analyze the great changes brought by this new technology by studying the impact mechanism of ChatGPT on the three major efficiencies of enterprises, with a view to contributing to the future development of the industry and policy formulation.

2 Impact of Chatgpt on Firms' Technical Efficiency

Technical efficiency reflects whether the factors of production invested by an enterprise in the production process are fully utilized or not.ChatGPT can be used to develop and upgrade automation systems to reduce manual labor requirements. Through the intelligent transformation provided by ChatGPT, enterprises can achieve more efficient production processes, reduce labor costs and promote technological innovation.

The impact of ChatGPT on the technological efficiency of enterprises is specifically reflected in the improvement of productivity through standardization, automation of work processes, costs and time spent, as well as through the collection and analysis of massive amounts of information in the process of innovation and research and development, which helps enterprises to collect market, competitive and consumer data to guide their corporate strategies and to improve the quality and competitiveness of their products and services.

Taking the equipment manufacturing industry as an example, the use of artificial intelligence improves production efficiency through standardized processes, control

of consumables and time, and optimizes the production model through data collection and intelligent analysis, which improves the competitiveness of enterprises. Sun Zao and Hou Yulin's empirical analysis based on provincial-level panel data of 23 manufacturing industries in China from 2001-2017 found that the total factor productivity of the remaining equipment manufacturing industries, except for the high-end sectors of the manufacturing industry such as the computer, communication and other electronic equipment manufacturing industry as well as the instrument and meter manufacturing industry, has been significantly improved by the application of artificial intelligence [5]. And ChatGPT, as a new type of artificial intelligence, its popularization and use will help enterprises invest in more key technology research and development, and further enhance the technical efficiency of high-end manufacturing enterprises.

In terms of management mode, ChatGPT has powerful processing and analysis capabilities for data, which will effectively alleviate the problem of information asymmetry in enterprises and maximize scientific management. ChatGPT can, through the collection, processing, and integration of historical data, shift from relying on the experience of a few people in decision-making to making decisions summarized after the analysis of large-scale data, thus promoting technological innovation within the enterprise and achieving Efficient development.

In terms of the business model, enterprises have gradually formed a mature intelligent system through the use of artificial intelligence, such as ChatGPT, and through the improvement of business efficiency and the collection of a large amount of data, enterprises can not be limited to their industries, broaden their business, and further promote the development of total factor productivity [6].

3 Impact of Chatgpt on Firms' Allocative Efficiency

Configuration efficiency refers to the optimal combination of input factors to produce the optimal number of product combinations. chatGPT can free employees from mechanization and other information search and screening work, and then more into more valuable and more complex work, which greatly improves the configuration efficiency and saves labor costs. At the same time, the use of artificial intelligence can replace the manual implementation of effective control and real-time supervision of the production process, to further enhance the efficiency of the enterprise configuration while reducing the product defective rate.

Enterprises can also improve allocation efficiency and achieve optimal output through cost control.ChatGPT can provide technical support for cost management in four aspects: cost accounting, cost analysis, cost control and early warning, and cost forecasting and planning [4]. (As Figure 1)

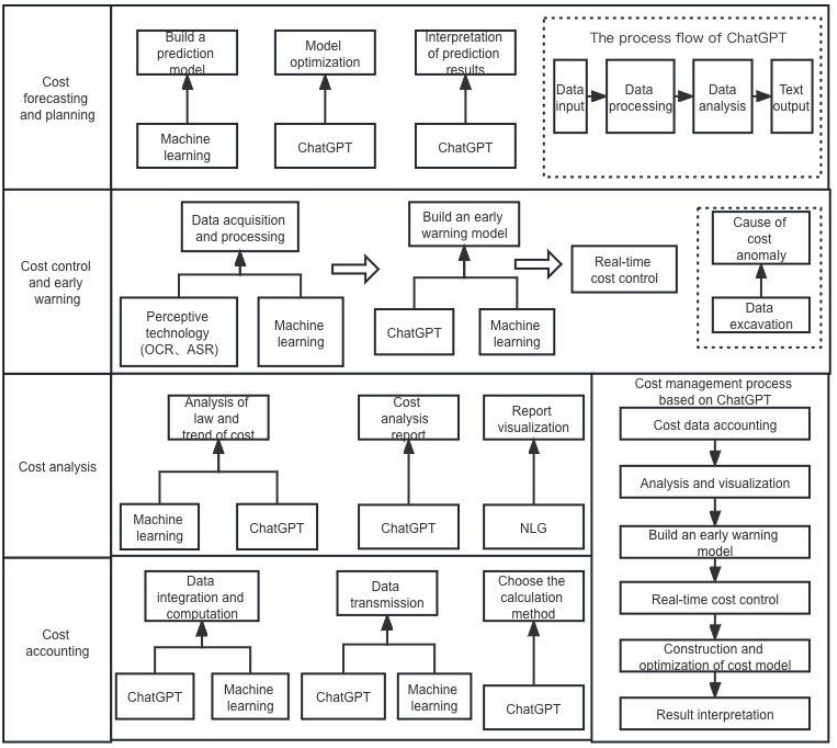

Fig. 1. Cost management framework model based on ChatGPT

In the costing of enterprises, ChatGPT firstly integrates data calculation from multiple data sources, then through automated delivery and process management to enable timely delivery of data, and finally selects corresponding calculation methods for different data types. ChatGPT helps enterprises to account for costs more accurately and improve efficiency and accuracy.

In the cost analysis of enterprises, firstly, ChatGPT summarizes the laws and trends of data through statistical analysis of a large amount of data, secondly, ChatGPT generates a cost analysis report in line with the company's situation through the processing and analysis of natural language, and finally, the report will be visualized in the form of text, images and other forms. By utilizing the advantages of

ChatGPT, we can provide companies with more mature cost analysis and better strategies for operators.

In the process of implementing cost control, it is necessary to carry out risk early warning of costs in order to achieve more efficient management. Different forms of enterprise cost data can first be captured using perceptual intelligence technologies, such as OCR recognition and intelligent voice recognition, and then the data can be cleaned, formatted and standardized to ensure their accuracy and consistency. Secondly, the early warning model is constructed to train the cost data and improve its accuracy. Finally, the early warning model will be applied in practice, when the cost exceeds the early warning value, enterprise managers can carry out real-time cost control and take reasonable measures. Traditional cost control is usually based on historical cost data to analyze the cost expenditure situation, and it is possible to ignore the enterprise's daily operating activities related to costs on a large number of business data, which may lead to cost control limitations. With ChatGPT, through its ability to summarize and classify data, it is possible to summarize patterns and trends from historical data, and achieve timely cost control in order to improve the level and effectiveness of cost control. By controlling costs and proposing accurate solutions, companies are able to utilize resources to organize production and achieve optimal output.

Accurate cost prediction is required for cost planning and a necessary prerequisite for managers to make correct decisions. Firstly, a large amount of historical data is collected and integrated through machine learning for training, then adjusted according to the new data to generate a cost prediction model, and then ChatGPT is used to predict possible anomalies in the cost prediction and further optimize the model to improve the prediction accuracy. Again, the efficiency and quality of cost prediction is improved through iterative training and tuning. Finally, visualization of the prediction results, combined with ChatGPT's processing and interpretation of natural language, improves the interpretability and communication efficiency of the prediction results.

4 Impact of Chatgpt on Firm Size Efficiency

Scale efficiency reflects the appropriateness of the size of the enterprise, and the necessary prerequisite for the improvement of scale efficiency in the digital economy is the ability of enterprises to use big data to expand the marginal productivity,

through the collection and analysis of data, and relatively accurate prediction of the effective demand for the provision of products and services.

It can be seen that there is a positive correlation between the technical efficiency and scale efficiency of an enterprise. The size of the scale efficiency of an enterprise depends on the collection and processing of various types of complex data types of big data.ChatGPT has the ability to collect, store, integrate, categorize, process and handle big data and can capture and predict products and services that meet the effective needs of the society. The premise of improving the efficiency of enterprise scale is that enterprises can improve the marginal productivity of production and service provision by analyzing big data, and make reasonable forecasts of product types and quantities through the collection, integration and analysis of big data. At the same time, ChatGPT can be combined with other intelligent technologies to transform non-digital data (e.g., language, images, sounds, etc.) into digital data, which allows enterprises to know more clearly what kind of products they should produce and what kind of services they should provide, so as to rationally arrange the number of products and services and improve scale efficiency[7].

ChatGPT automates mundane or repetitive tasks, thereby freeing employees from repetitive and tedious tasks, allowing them to focus on creative and non-repetitive activities, maximizing the use and rational allocation of AI as well as human employee jobs, thereby regulating the number of employee positions, controlling the size of the business and saving on labor costs. Secondly, ChatGPT, as a generative AI based on language models, has a more efficient learning process compared to other AIs, which reduces the cost of education through the collection of data and training, in order to optimize the human capital structure of real economy enterprises, thus regulating the size of the enterprise and improving the efficiency of production.

In addition, the gradual promotion of ChatGPT has stimulated the business vitality of enterprises, not only motivating Internet enterprises and technology enterprises to expand their business segments, but also stimulating many real enterprises and enterprises in traditional industries to get involved in the field of artificial intelligence, thus realizing the digital transformation and development of enterprises, and thus enhancing the scale efficiency.

The realization of the enterprise internal scale efficiency improvement, mainly rely on the use of big data and artificial intelligence technology investment operation, for product production and service provision demand prediction, followed by the deployment of resources within the enterprise, through a reasonable allocation of

resources to control the size of the scale. ChatGPT, as a new type of AI, has sufficiently mature technology to process all types of complex data, improve enterprise scale efficiency, and drive total factor productivity.

5 Conclusions

Training in ChatGPT-type AI can improve internal management costs, leverage resource allocation, and achieve technological efficiency growth. Maximize the value of output and improve allocation efficiency. Controls timely changes in the size of the enterprise and realizes a rise in scale efficiency. It may also improve the efficiency of enterprise technology development and increase the rate of technological progress.

In terms of technical efficiency, ChatGPT helps to realize semi-automated or even automated production and reduce labor costs through intelligent transformation in some manufacturing industries with escalating labor costs. In addition, it uses data mining analysis and other technological means to capture the trend of changes in market demand, enhance the production efficiency of enterprises, and promote technological innovations, so as to improve the technological efficiency of enterprises, and provide a positive impetus to the total factor productivity. However, for high-end manufacturing, AI has not been able to accomplish highly technical and innovative production tasks through simple automation.

The digital economy can improve the efficiency of resource allocation by reducing search costs and transaction costs, etc. ChatGPT can free employees from mechanized information search and screening work, and then more into more valuable and more complex work, which greatly improves the allocation efficiency and saves labor costs. At the same time, artificial intelligence is put into use to implement effective control and supervision of the production process, thus reducing the rate of defective products and further improving the allocation efficiency of the enterprise.

ChatGPT has a positive effect on the scale efficiency of an organization. For internal enterprises, the utilization of ChatGPT allows more manpower to be devoted to more complex work, controls the size of the enterprise, and improves scale efficiency. Expanding the production scale by reducing the unit production cost and relatively increasing the output value and profit. At the same time, combined with the collection and analysis of big data, it constantly explores market demand and improves supply to expand production scale.

In conclusion, it is expected that the use of ChatGPT-type AI has a significant positive impact on the total factor productivity of enterprises, and should be combined with the actual situation of enterprises to maximize the use of new AI tools to help improve technological efficiency, allocation efficiency, scale efficiency, to achieve their own profit goals, and to take advantage of competitive advantages.

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