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The Artificial Intelligence Technology: Evidence from Chinese economy

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ABSTRACT: This work examined artificial intelligence (AI) influences an economy in China. AI plays an increasingly important role in our economy. AI has the potential to become the engine of productivity and economic growth. AI stands for simulating human intelligence in machines programmed for human-like-thinking replicating their actions. This paper basically spins around ideas and uses of AI in Chinese economy. There are evidences, we reviewed, showing that AI affects economy significantly. This work used a literary survey to collect data and information from different resources. To collect AI data, we depended on the international organizations' statistics related to AI-economic performance correlations. International Federation of Robotics, Tortoise Media and McKinsey Global Institute is the latter category that belong to specific data sources. This work examined the influence of AI on China's economic activity and the industrial structure in this relationship.

KEYWORDS: Artificial intelligence; Chinese economy; robotics economic growth

1. Introduction

AI is a paradigm in which the computers or machines perform tasks with high level cognitions.AI is capable of transforming economic growth, commerce, and trade which affect available jobs and needed skills. China and others recognized the opportunities and support AI research and development in addition to the preparation of their workforce. According to Corradoet al. (2021),by 2025, all the universal market for robots and AI will be $248 billion and raises productivity by 30% in specific sectors. During 2016 to 2019, 8 million robots were distributed worldwide in education and science only. China depends on technological development and innovations. Also, by no means, its economy grows rapidly and steadily and there are education and uses of technological advancements. Also, the optimal use and factor production allocation are employment and capital productivity offering many opportunities for high-speed growth. Investments, the GDP per capita level, and growth of population are most important for economic progress in China, as seen in the Solow Model. Fan &Liu, (2021) stated that capital accumulation is most critical for growth in addition to structural change and a slower population growth. Tchamekwen & Xicang, (2019), also found that activities related to robotics increased nearly 0.4% to the GDP of 17 countries. China expands its leads in industrial robots up to 36% in 2017 which shows increasing in rate of global sales more than 30% in 2016. The expected future statistical shows rising in the year of 2030 with approximately14 million industrial robots in use just in China (Alonezi & Al-Dhlan,2021).Today, the automation in China is mostly provided through overseas robot manufacturers with a combined market shares of 73%. Certain volatility in the last eight

years has made this share stable. In 2020,installations of robots internationally – mostly come from Japan, Korea and Europe –growing significantly by 24% to 123,030units (International Federation of Robotics-IFR,2021).This number refers to the units made in China which are made by non-Chinese suppliers. Chinese robot manufacturers mostly send their products to their local markets, in which they have market shares of 27% in 2020 with 45,347 units exported (IFR,2021).This paper has looked into the economist's perception towards the AI. This work examined AI influence the economy in China, as it was the top the ranking for AI universally and in the Asian region. This paper proposes a framework used by researchers to analyze the same cases. The remaining part of the paper is organized into: In Section 2, the theoretical foundation. In Section 3, work methodology, In Section 4, the results are shown, and the last section concludes the paper.

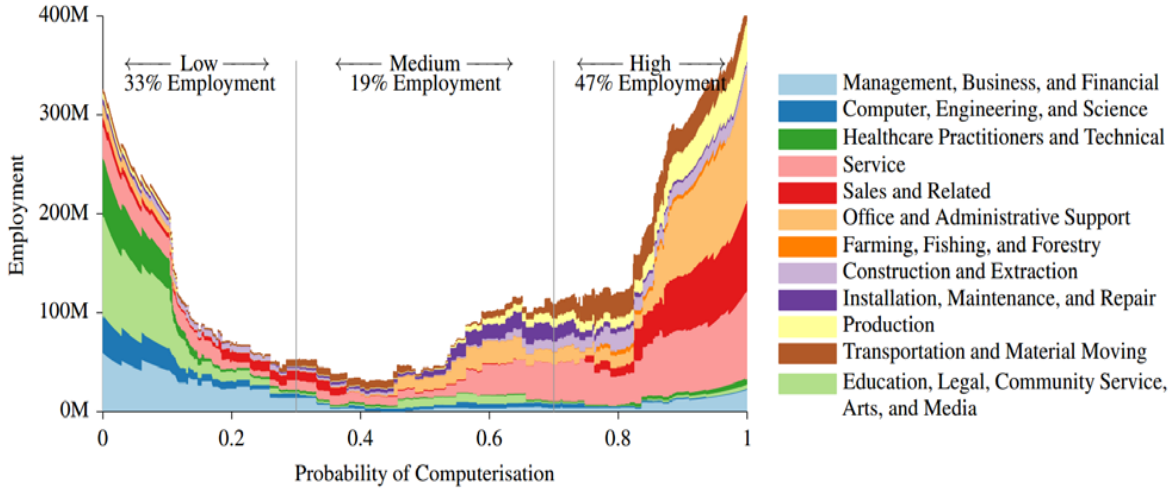
2.Theoretical Foundation

In 1950, Alan Turing introduced the idea of AI to the London Mathematical Society with his Turing test, in which he sought to answer the question: "Can a Machine Think**?** (Pticek& Dobrinic**,** 2019).John McCarthy, is the pioneer of AI. John McCarthy started studying AI in 1955 assuming that individual elements of learning and other intelligence domains could be accurately defined and simulated by automations (Donepudi et al.,2020).AI is known as "the capability of a machine to imitate intelligent human behavior" or "an agent's ability to achieve goals in a wide range of environments" (Aghion et al.,2019).Based on the AI definitions from literature, the concept of AI is a set of tools and technologies with the abilities of augment enhancing economic performance.

According to the Solow-Growth Model, technological advancement is exogenous in economic growth. Solow's study by the use of the US data showed that technology improved economic growth (Solow, 1956). In addition, Romer (1990) is first to found R&D-based endogenous growth models who stated that economic growth and productivity are positively correlated with technologies are based R&D. Throughout history, scholars worried that the automation, such as mechanization, computing, and in the more recent years AI and robotics, could reduce jobs and create irreversible damages to the labor market. For instance, John M. Keynes defined technological unemployment as "unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour (Furman & Seamans, 2019).From this narrow perspective, robotics and AI are expected to either directly replace employees or increase productivity and thereby induce unemployment (and affect real wages) in sectors in which the technology is applied.

This is compensated merely by (i) an increase in demand for higher skilled employees in the sector of application to exploit complementarities of using the robot technology, (ii) a(n) (possibly marginal) increase in labor in the sector in which the technology is developed and produced, and (iii) increased demand for products because of lower production costs (Vermeulen et al.,2017).Frey & Osborne (2017) study which occupations are at risk of being computerized/ automatized and they find that almost half of the jobs in the U.S.A. are potentially automatable. Figure 1,shows that particularly employees in administration, transportation and logistics as well as labor in production are at risk. Arguably, technological progress may exacerbate the (potential) replacement.

Figure 1. Distribution of employment over the probability of computerization



Source : Vermeulen & Omeroviv, 2017

According to a study made by Bank of England in the next 10-20 years' automation may eliminate about 80 million jobs in USA and 15 million jobs in Great Britain; the mentioned figures represent about 50 % of the workforce in the two countries (Haldane, 2015). Other estimates originating with Forbes indicate the elimination of 35 - 50% of the workforce of the two countries in the same time interval (Marr, 2017).A recent study released by McKinsey Global Institute, (2017) shows that by 2022 about one fifth of the global workforce will be affected by the embracing of AI and automation, with the most significant impact on developed countries such as the UK, Germany and the US. The same survey reveals that by 2022, 50% of companies believe that automation will reduce the number of full-time employees and by 2030, robots will replace 800 million workers around the world.

We also predict the number of employed people that would be replaced by AI in each industry, and the results show that China will have 278 million labors (201 ~ 333 million under different adoption rates) replaced by AI by2049, representing 35.8% of the current employment in China (Zhou et al., 2020). AI has transformed almost all aspects of the human life in this knowledge millennium. The domains that have witnessed the growing influence of AI applications include the automobile industry with the emergence of driverless cars, media and communication through news feeds, business operations by influencing consumers' buying decisions and behaviors, and last, but not the least, in the field of telecommunication through digital device functionality (Agrawal et al.,2018).After all, the impact of the diffusion and adoption of robotics and AI on the economy is multi-faceted, affecting not only existing sectors which develop & produce or apply the focal technology (Vermeulen et al.,2017).It also affects sectors that supply to the developing & producing sector and sectors that facilitate changes within the various sectors and notably the sector of application (intra-sectoral transformations).What is presented till now is just the recent development of AI with its subsets in their evolutionary form. As it can be seen it has taken almost 70 years (1950 – 2020) to reach the current AI status.

3.Work Methodology

This work used a literary survey to collect data and information from different resources, with the consideration of the published resources, the impact factors of the reviewed articles and the governmental statistical. The collected information used to answer the research questions, and help to draw the conclusions. With the economic science being made up of generalization of their results, actually, theoretical studies impose special requirements for the nature of reasoning and logic of presentation of the results of the analysis conducted. The principal problem of theoretical research consists in its deductive nature. Moreover, such a deductive nature of theoretical research is the only possible form of conducting it. It goes without saying that situations are quite possible when the final theoretical provisions of a completed study can be backed up by certain economic statistical material. With the primary aim being the examination of the potential impact of AI implementation on the future of Chinese economy. For the collection of AI data, the work relied on international organizations' statistics concerning the AI-economic performance correlation. Specific data sources belonging to the latter category included the International Federation of Robotics, Tortoise Media and McKinsey Global Institute.

4. Result and discussion

As with the Information Technology benchmark, the broadband benchmark papers focus on high-income, developed nations. So the focus is on the implied impacts of AI for high-income countries as well, multiplying the adjusted annual contribution to economic growth by projected GDP estimates for these countries through 2025. The resulting range implies that if AI performs equivalently to historical broadband, then AI could have a cumulative economic effect between $1.49 trillion and $5.89 trillion through 2025, or alternatively, between 0.2% and 1.0% of GDP for high-income countries during those same years (Chen et al. 2016). These calculations and results are summarized in Table 1.

Table 1: Estimated Economic Effect of AI from Potential Broadband Benchmarks

	High Income GDP $ (Millions)	Estimated AI Diffusion Rate (per Broadband)	Qiang and Rossotto Study*	Czernich et al. Study** (Lower)	Koutroumpis Study***
Annual %Pts. of GDP Growth			1.21%	0.90%	0.25%
2015	53,868,829	0.01%			
2016	55,000,074	0.06%	3,993	2,970	--
2017	56,155,075	0.30%	20,384	15,162	--
2018	57,334,332	1.21%	83,943	62,437	--
2019	58,538,353	2.93%	207,536	154,366	--
2020	59,767,658	4.87%	352,193	261,962	--

2021	60,843,476	7.28%	535,958	398,646	--
2022	61,938,659	10.34%	774,939	576,401	--
2023	63,053,555	13.78%	1,051,342	781,990	--
2024	64,188,519	16.79%	1,304,048	969,953	--
2025	65,343,912	19.65%	1,553,650	1,155,607	--
Total	602,163,614		5,887,986	4,379,494	1,485,122
Percent	100%		0.98%	0.73%	0.25%

Source : Chen et al. ,2016

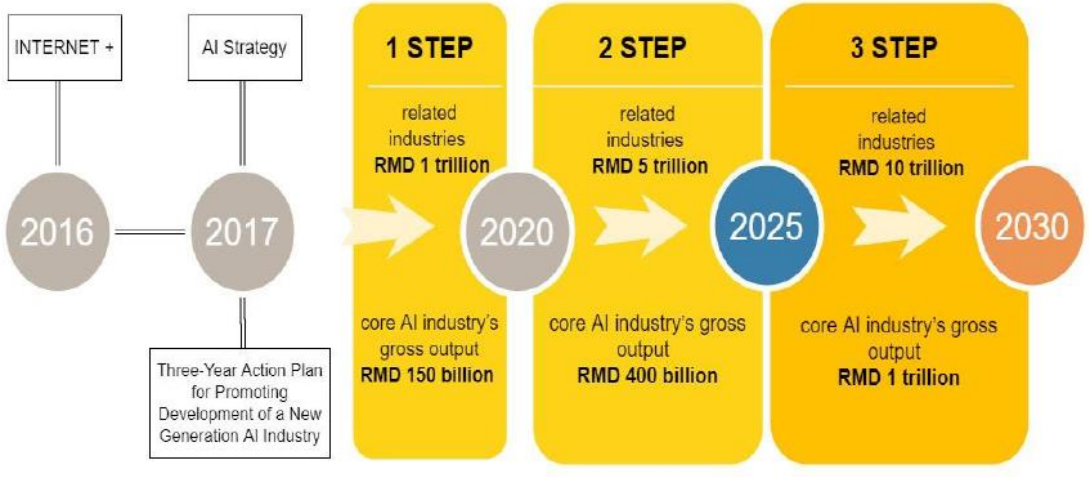
*Qiang and Rossotto (2009). Economic Impact of Broadband, https://www.semanticscholar.org/author/C.-Qiang/46211943

**Czernich, N.et al., (2011). Broadband Infrastructure and Economic Growth." The Economic Journal, 505-530.

***Koutroumpis, P. (2009).The Economic Impact of Broadband on Growth: A Simultaneous Approach." Telecommunications Policy, 471-485.

AI and robotics could contribute up to $ 15 trillion to the global GDP (Tchamekwen & Xicang,2019).McKinsey's report of 2017 stated AI improves the economic productivity of China by 0.8 - 1.4 annually. In July 2017, the State Council of China produced development principles of AI. Also, it set aims to transform China into a main universal innovation Centre by 2030. Then, the State Council of China estimated that the whole values of AI industries' manufacturing increase to more $148 billion in 2-3 years (Dobrescu & Dobrescu, 2018).Chinese government plans to focus on the 2030 and afterward. In all areas, thus, AI is combined into the strategic aim-setting systems. The "Next Generation AI Development Plan" is intertwined with other documents of strategies, and the rank of AI improvement aspects issues is the sixth among 69 key responsibilities. The documents contained three reference points: in 2020, 2025 and 2030 (Figure 2).

Figure 2. AI Strategy in Chinese economy

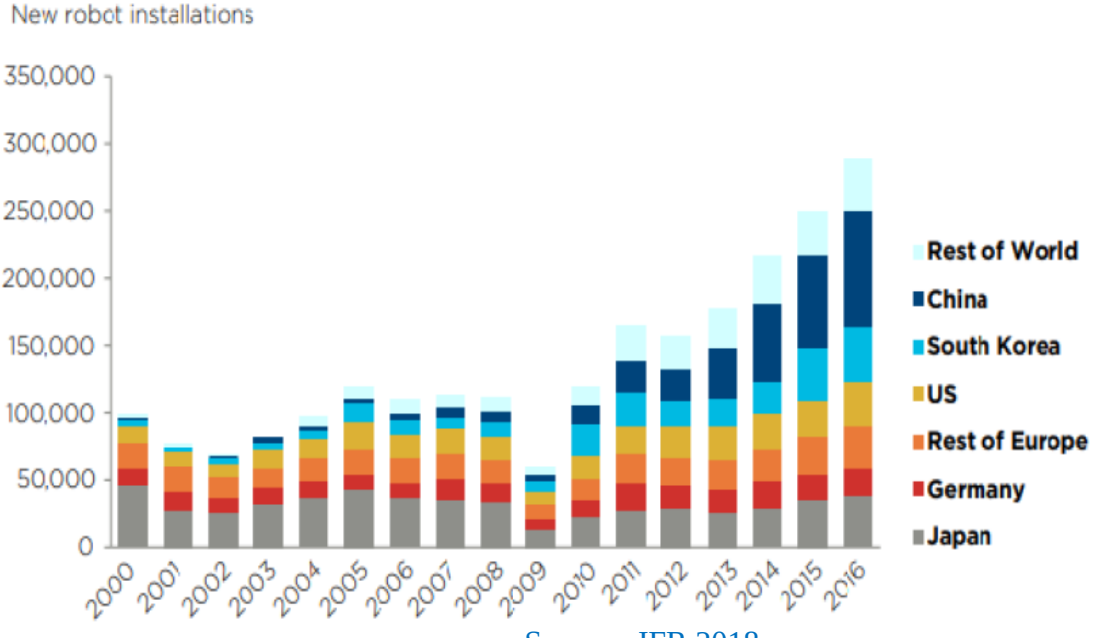


Source: Grinyaev et al., 2021

In 2030, China could lead the world in AI development and invention. American experts described China in this field as forceful investments (Westervelt, 2019). The available data showed China has invested about 170 billion USD annually. The investment will increase to more than$ 800 billion by 2025. The costs of AI in America reach$ 26 billion annually (Grinyaev et al., 2021).

Rising of robots in economy depends on two issues, the increase in quality and efficiency more than anything else because they are scalable through production lines.
Robots are widely used in big or small factories that are working in a large or small product. In 2000 the rate of countries which installed robot's technology were divided in 6 main countries (IFR,2018), such as Korea, Taiwan, India, Brazil, and Poland. But who get the big share of the total stock from the shown statistical, is China indeed with more than fifth of the world's total stock of robots (see Figure 3).

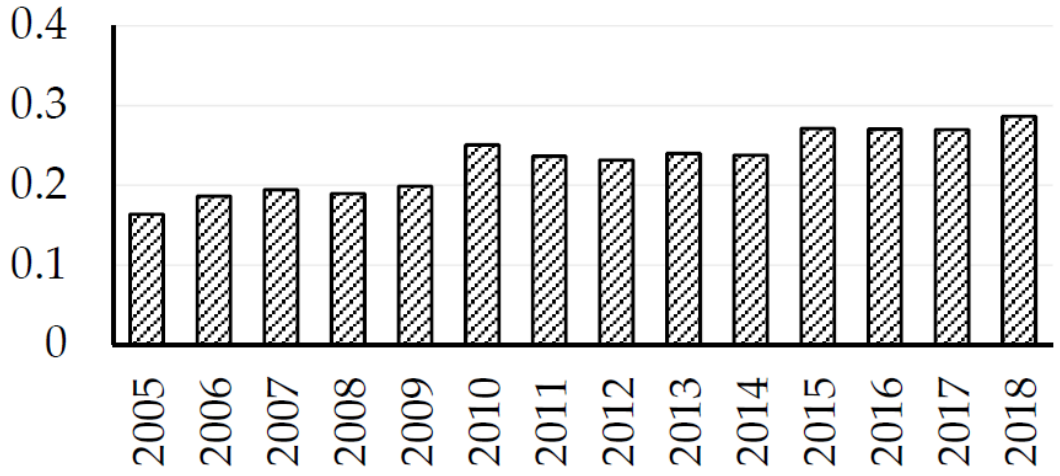
Figure 3. Installations of industrial robots in Chinese economy and selected countries



Source : IFR,2018

So, in 2020, AI technologies could be new factor to grow the national economy and China will be in a position to lead the world in AI development. In 2025, AI will be a key element for the Chinese economy. Figure 4 depicts the shifts in China's intelligence index from 2005 to 2018. In addition, the figure shows that intelligence level of China increased quickly. Yet China's AI index speed has reduced recently, and the general trend fluctuates upward (Fan& Liu, 2021).

Figure 4. AI development in Chinese industry



Source : Fan& Liu, 2021

The data on AI shows that AI ranks, in relation to innovating, implementing, and investing based on the AI Global AI Summit Report as Table 2 shows.

Table 2. The Global AI Index in Chinese economy and selected countries

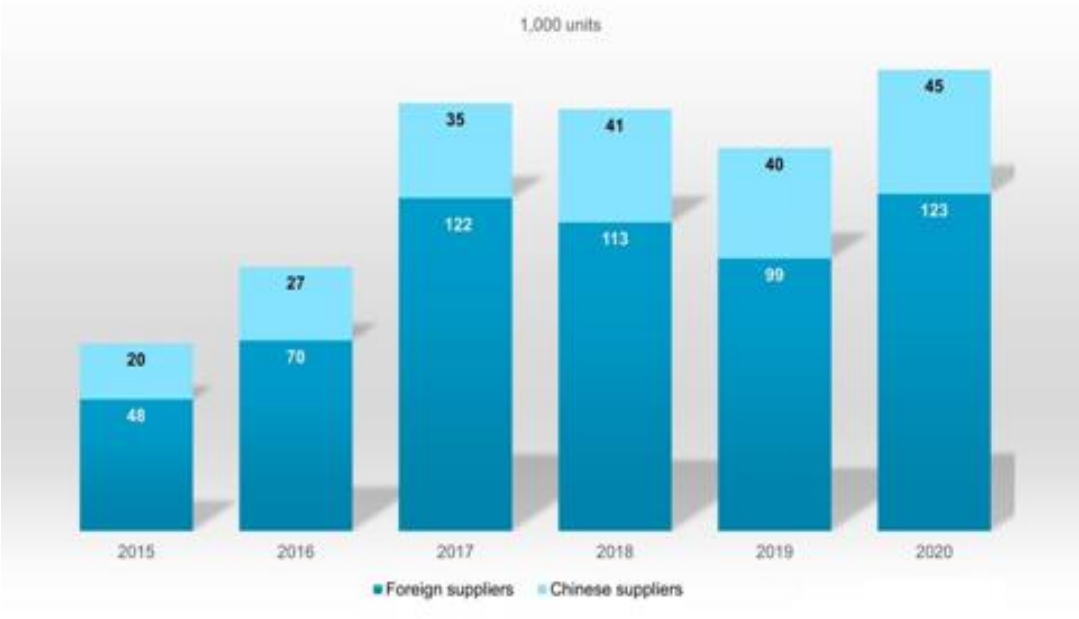
Rank	Implementation			Innovation		Investment		Final Rank
Country	Talent	Infrastructure	Operating Management	Research	Development	Government Strategy	Commercial	
China	18	3	3	2	1	1	2	2
Singapore	2	4	39	16	15	30	6	7
Japan	26	16	17	6	7	12	8	9
India	2	59	33	27	11	36	10	20

Source : Tortoise Media, 2019

These data and indices are the AI determinants, in general with the AI implementations in public sectors including healthcare, transportation and education. Next, innovation where AI startups to sustain the economy is used to develop industries and infrastructures. Then products and services of high R&D intensity are invested as high-technology export (Tortoise Media, 2019). The new 5-year plan for the China robotics the Ministry of Industry and Information Technology (MIIT) in Beijing aims to promote invention - making China a universal pioneer for robot technologies and advancement

of industry (IFR,2021). IFR,2021stated that China the largest robot marketplace universally in terms of annual sales and the operational stocks. IFR´s robot density statistics shows China´s dynamic developments showing industrial robots per 10,000 personnel: the rank of China´s robot densities in the manufacturing industry is 9th universally (246 units) –in comparison to 25th (49 units) the last 5 years (see Figure5).

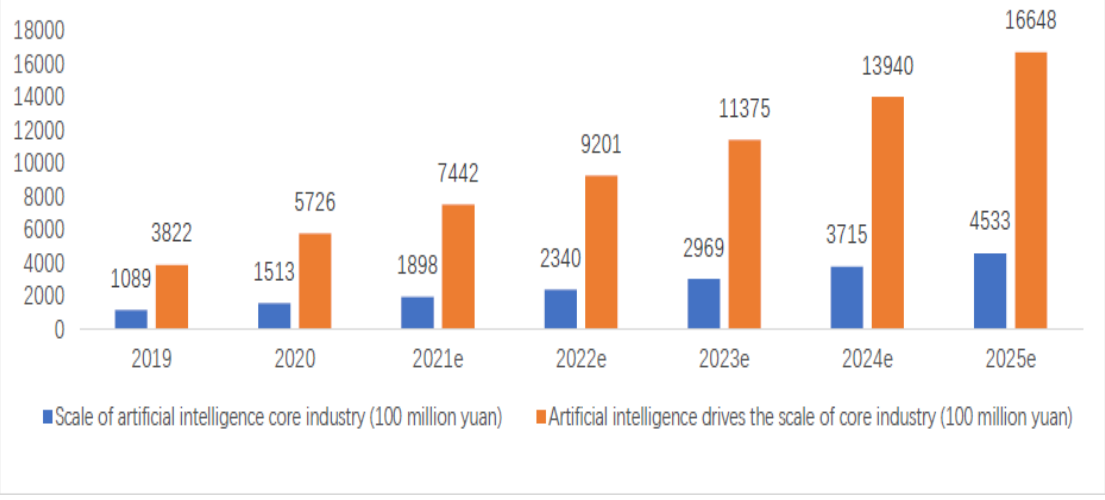
Figure 5. Annual installations of industrial robots in Chinese economy



Source : IFR,2021

Hu et al., 2021, China's AI industry scale could be more than 180 billion yuan in 2021 and it is estimated that it will be higher than 450 billion yuan in 2025. The compound annual growth rate (CAGR) of AI manufacturing from 2021 to 2025 could reach 24%.AI related industry scales could be 740 billion yuan in 2020 and in 2025 it will be more than1.6 trillion yuan. Also, The CAGR of AI-related businesses from 2021 to 2025 could reach 22%. In the new industry background, new business types, and models, the AI growth rate outcome values and the industrial scales by it are notable (see Figure 6).

Figure 6.China's AI industry and the scale of related industries



Source : Hu et al., 2021

In the integration of the digitalization, intelligence, and networking, the mechanisms and influences of AI on China's economy are larger than those of usual ones. AI could optimize allocating industrial resources by the science and industries of technology services constituting a significant support for macro economy (Akaev & Rudskoi,2017).Zhou et al., (2020) highlighted the predictable AI adoption rate in 2049 with industries according to the three sub-indexes, as Table 3.It is assumed that the present AI application levels could shift in the different steps. Also, the coefficients of enhanced fitting could take various curves in the coming three decades. The calculation of AI adoption with professions could match the professions with industries.

Table 3. AI adoption rate by selected sectors in Chinese economy

sector	Adoption rate, 2017 (%)	Digitization rate, 2017 (%)	Digitization potential	Increases in fitting (to 2049)	Adoption rates, 2049 (%)		
					Low	Medium	High
Manufacturing	3.7	2.0	4.00	4.34	46.3	64.2	68.7

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computer services, and software	8.0	4.0	2.00	2.57	35.3	41.1	61.4
Financial intermediation	14.0	5.0	1.60	2.57	49.4	57.3	85.8
Leasing and business Services	2.0	6.0	1.33	4.64	11.6	12.4	17.7
Education	3.0	3.9	2.05	4.64	26.6	28.5	40.6
Health, social security, and social service	0.5	0.8	9.76	4.64	21.2	22.6	32.3

Source: Prepared by the author with information from Zhou et al., 2020

The occupations list accords with the official two-digit codes, whereas the correspondence is a rough concluding with the concept of occupations. It is a precise unavailable industry employment numbers. Most occupations are associated with a single; for instance, Financial professionals could be linked to Finance Industry. Yet, the AI development could not finish, no matter how many real implementations nowadays there are. AI has a very long predicted future for further improvement and development. The literature has shown that the digital technologies affects innovation, profitability and growth at the macro and micro level. Putting emphasis on the case of China, analysis based on six years 2013-2018 reveals that the share of digital economy in China's GDP is rapidly growing (Tchamekwen & Xicang,2019). The market size of the country's digital technologies is expanding and being applied to various business sectors and economic activities, making them to more effectiveness, performance and productivity.

5. Concluding remarks

Automation and AI technology has pivotal role in modern economic and social development. They would be labor-substituted technological progresses, with extra jobs substituted by AI.As China's economy witnesses a fast economic growth and rapid transformations in the economic structure, it is an instance of a developed country with a developed education, economy, uses of technological advancements and inventions. It also optimal uses and allocation of the production factors including labor and capital productivity offering big potentials to extra developments and high-speed growth. With the rapid development of the technological revolution, China faced a dual challenge of technological upgrade and economic growth. The broad AI application shave slowly turned into new ways for achieving a high-quality economic development. This work examined the AI influence on China's economic activities and the roles of industrial structure in the relationship. The findings indicate China could have 278 million labors (201 ~ 333 million in various adoption rates) AI substituted by2049 which represents 35.8% of the current China employment. The government could impose more tax. It could also transfer payment systems such as taxing AI equipment or robots for subsidize the replaced workers or improving their professional skills. In addition, to deal with the old-

age pension shortages due to aging, the tax could be used. It is important to execute the Cyber Security Law and the Data Security Law of the China.

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