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국제학석사학위논문

An Analysis of China's Demographic Transition to the Economic Development

중국 인구 전환의 경제발전에 대한 시사점 분석

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국제학과 국제통상전공

강 민 규

Master's Thesis of Min Gyu Kang

An Analysis of China's Demographic Transition to the Economic Development

중국 인구 전환의 경제발전에 대한 시사점 분석

August 2023

Graduate School of International Studies

Seoul National University

International Commerce Major

Min Gyu Kang

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중국 인구 전환의 경제발전에 대한 시사점 분석

Young-Rok Cheong

Submitting a master's thesis of
International Commerce

August 2023

Graduate School of International Studies
Seoul National University
International Commerce Major

Min Gyu Kang

Confirming the master's thesis written by

Min Gyu Kang

August 2023

Chair	**Yeongseop Rhee**
Vice Chair	**Taekyoon Kim**
Examiner	**Young-Rok Cheong**

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Abstract

The development of China's labor-intensive secondary industries based on low-wage and abundant working-age population emerged as the blue ocean for foreign companies' foreign direct investment (FDI), which had struggled with the rise of wages in their own countries. Therefore, China achieved excessive overseas capital investment while processing the export-oriented economic reform by implementing the Open-Door Policy of 1978, and the coastal development strategy in the 1980s. After the global financial crisis of 2008, however, China's exports have decreased due to the economic downturn in overseas markets, mainly in developed countries. The export-oriented manufacturing industry of China has also suffered due to the recession. While recovering from the economic crisis, China implemented strategies to promote the domestic market to offset the decline in exports.

Meanwhile, China was able to utilize the abundant labor force, while maintaining a low youth dependency ratio through the "One-Child Policy" and a decrease in the total fertility rate. On the other hand, the proportion of the working-age population started to decline after reaching its peak of 72.94% in 2009, and the share of the secondary industry in GDP also began to show a gradual decline. In the future, due to the rapidly aging trend of China's population, the total dependency ratio may increase while household savings decrease, which could burden the working-age population.

On the other hand, unlike in the past, when human resources were a key factor in most of the production work, the 4th industrial revolution based on digital transformation is emerging as a new driving force for economic development. Hence,

the following changes in the economic mechanism from labor-intensive to high-tech-intensive could neutralize the negative effect of the demographic onus trend. For instance, the automation systems by artificial intelligence (AI) and robots could replace roughly about 14 million jobs in manufacturing sectors by 2030. Moreover, China is actively ‘smartizing’ not only labor-intensive industries, but also almost every existing industry through digital transformation, including the service industry.

Therefore, this paper first analyzes the impact of the demographic bonus on China's economic growth through the increase in the working-age population. Then, challenges and implications will be discussed in terms of the demographic onus. Furthermore, the impact of a smart-intensive phenomenon on the demographic transition as the new kinetic energy to the further economic development will be evaluated.

Keyword: economic development, demographic transition, demographic bonus, demographic onus, labor-intensive, smartizing industries

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I. Introduction

1.1 Research Background

Since the 1980s, China achieved rapid economic growth based on labor-intensive industries through the demographic bonus of the increase in the working-age population until 2009. The high proportion of the working-age population with low wages was more than enough to attract foreign companies along with the economic reform by implementing the open-door policy of 1978, and the coastal development strategy in the 1980s. Thus, china achieved and maintained high-speed economic growth led by export-oriented economic development with low wages and an excessive amount of FDI. While overcome with the economic recession due to the global financial crisis of 2008, however, China implemented strategies to promote the domestic market through expanding domestic market supply and utilizing purchasing power of the 1.4 billion population in order to offset the decline in exports.

China was able to maintain the demographic bonus by a high proportion of working-population and the low total fertility rate under the birth control policies, which had a positively affected the economic growth. Starting from 2010, however, the proportion of the working-age population started to decline after reaching its peak of 72.94% in 2009, and predicted to be 58.5% in 2050. The proportion of China's working-age population is gradually decreasing, mainly due to the decline in the total fertility rate. Also, the demographic onus trend may occur in the future since the total dependency ratio is rising due to the low fertility rate and population-

aging, which may indicate a negative impact on future economic growth with various economic variables.

Therefore, this paper analyzes both the effects of the demographic bonus and challenges of the demographic onus, while emphasizing digital transformation as the new kinetic energy to future economic development. First, in Chapter 2, Malthusian Trap and China's birth control policies are reviewed, and the correlation between Chinses economic reform and population is analyzed in Chapter 3 with the idea of demographic bonus. Lastly, the challenges of the demographic onus trend and the effects of digital transformation will be evaluated in Chapter 4.

1.2 Literature Review

The demographic bonus trend positively affected to China's economic development through developing labor-intensive industries and export-oriented economic development. Also, maintaining a low youth dependency ratio was possible by implementing the one-child policy while utilizing an abundant labor force. The foundation of the birth control policy was a Neo-Malthusian perspective regarding the relationship between population and economic development (Feng and Mason 2005). Feng and Mason (2005) also pointed out that the demographic bonus trend may occur when increase of the working-age population is faster than that of the total population, and it will eventually slow down with the rise of the population-aging trend.

Nowadays, China is facing the demographic onus trend since the proportion of the working-age population is gradually decreasing. Also, widely known as the demographic cliff, the following transition may cause a massive shrinkage of

economic activities in terms of both production and consumption, ultimately sluggish economic growth (Dent 2014). More specifically, Zhang (2003) asserted that the demographic onus trend could adversely impact on national savings. Also, the total dependency ratio will continue to rise since the increase in the old-age dependency ratio is faster than that of the decrease in the youth dependency ratio (Zhang 2003). Furthermore, *the Economist Magazine* (2023) insisted that a shrinking in the working-age population indicates a reduction in the future labor forces, and rising expenditure for health care and pensions. In addition, Gruber and Wise (1998) asserted that the demographic onus trend may obstruct the financial viability of the social-security systems.

To deal with the demographic cliff trend, Dent (2014) suggested promoting immigration and increase of the fertility rate as solutions. Son (2014), on the other hand, insisted that to cope with the negative effects of a decline in the working-age population to the economy, it is necessary to improve the investment conditions so that FDI and stable capital inflow may appease the impact of demographic transition.

Overall, various methods were suggested to overcome the negative impact of the demographic onus trend. However, the increase of the amount of FDI and encourage immigration may not be the suitable key solution for China nowadays. The timing and circumstances of the demographic transition may vary by region and nation (Galor 2005). Instead, I believe digital transformation and high-tech-intensive development may neutralize the negative impact of the demographic onus trend by substituting the needs of manpower in the 21st century. Labor by manpower was a key factor for the economic development in the past, but digital

transformation is emerging as a new catalyst nowadays in the era of 4th industrial revolution. Therefore, this paper will analyze the correlation between economic development and demographic transition, while evaluating the possible influence of digital transformation phenomenon.

II. Population and Economic Development

2.1 Malthusian Trap

Malthus (1798) asserted the power of population growth in his book, *An Essay on the Principle of Population*, which was originally published in 1798. He argued that human poverty is a natural phenomenon because the growth of food production is arithmetic, while population growth is exponential. Therefore, the following disproportionate may cause conflicts and problems. Malthus insisted that,

> *"Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second. By that law of our nature which makes food necessary to the life of man, the effects of these two unequal powers must be kept equal. […] This difficulty must fall somewhere and must necessarily be severely felt by a large portion of mankind."*[1]

[1] Malthus, T. R. (1982). An essay on the principle of population. Harmondsworth: Penguin, p.4. (Originally published in 1798)

Also, he stated that the population could be reduced by two factors such as positive and preventive checks. The positive check is about the malnutrition, disease and famine, while the prevent check refers to the intentional reduction of the total fertility rate.[2] Moreover, demographic change is closely related to economic development. Malthus argued that the standard of living is high when the population size is small, but the standard becomes lower while the population grows.

On the other hand, Mao Zedong, the founder of the People's Republic of China, asserted that Malthus's argument was limited to food and consumption, so instead, he emphasized labor productivity. For instance, Mao claimed that production could keep up with population growth because every person has one mouth, but two hands (人手論). It was a reasonable idea since most of the production labor was done by human resources. Thus, China actively implemented the birth encouragement policy from 1949 to 1953 to increase the number of the labor force and to promote the industrial development. After the issue of rapid population growth was raised, however, China implemented a birth control policy called the "Family Planning Policy (计划生育政策)" affected by Malthus's theory, which has specific birth quotas regulated by the government.

[2] Galor and Weil (2000). "Population, Technology and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond", *The American Economic Review*, Vol.90 (4), p.807.

2.2 One-Child Policy in China

The birth encouragement policy was actively carried out to attempt industrial development through an increase in the working-age population from 1949 to 1953. The first census in 1953, however, recorded population growth that far exceeded its projections, which led to the rapid population increase to be discussed as a social problem.[3]

<Table 1.> Phases of China's Childbirth-related Policies

Year	Childbirth Policy	Main Point of Policy
1949 to 1953	Birth Encouragement	As Many as You Wish
1954 to 1969	Birth Control	Late Marriage Encouragement
1970 to 1979	Birth Control Plan	3 Key Goals (Later, Longer, Fewer)
1980 to 2010	One-Child Policy	One Child per a Household
2011 to 2015	Limited Two-Children Policy	Limited Allowance of Two-Children
2016 to 2020	Comprehensive Two-Children Policy	Full Allowance of Two-Children
2021 to Present	Three-Children Policy	Three-Children Allowed

Source: Kim and Hwang (2019), p.223.

[3] Kim and Hwang (2019). "An Analysis on the Low Fertility Crisis and Policy Adjustment in China", *Journal of China Knowledge Network*, Vol.14 (14), p.224, also stated that due to historical and social events like Great Leap Forward and the Cultural Revolution, policies related to population were not prioritized.

Overall, the total population exceeded 940 million in 1976, nearly doubling from 1949, raising concerns about the excessive population growth.[4] Thus, Deng Xiaoping, the second Chairman, implemented the one-child policy actively since excessive population growth could hinder China's economic development. The following family planning policy had a specific birth quota of one child per a household, which was regulated by the government. Likewise, South Korea and Japan recorded high total fertility rates in the past, and Korea also implemented birth control slogans such as 'Just Two Children and Raise Them Well' in the 1970s and 'Two Are Too Many' in the 1980s in order to manage the total fertility rate and enhance economic development.

In 2011, the Chinese government extensively implemented the "Limited Two-Children Policy" while abolishing the one-child policy due to rising concerns of the low total fertility rate and population aging trend. Moreover, in October 2015, at the 5th Plenary Session of the 18th Central Committee of the Communist Party, the Chinese government announced the "Comprehensive Two-children Policy" and implemented in 2016. However, there were various social problems such as an excessive amount of childcare costs and the population-aging trend, etc.[5] Even after implementing the comprehensive two-children policy in 2016, the number of newborns in China continued to decline from 17.86 million in 2016 to 17.23 million

[4] Do (2019). "Changes and Issues in Low Fertility Policy in East Asia (Korea, China and Japan)", Childcare Policy Research Institute, Childcare Policy Forum, Vol. 59, p.39.

[5] Ibid., p.41.

and 15.23 million in 2017 and 2018, respectively.[6] Recently, China announced the "Three-Children Policy" at the 14th National People's Congress meeting held in May 2021. Although China's birth control policy is stipulated as the "Three-Children Policy", the population policy trend has shifted from 'birth control' to 'encourage childbirth'.

[6] Kim and Hwang (2019). pp.227-228.

III. Chinese Economic Reform and Population

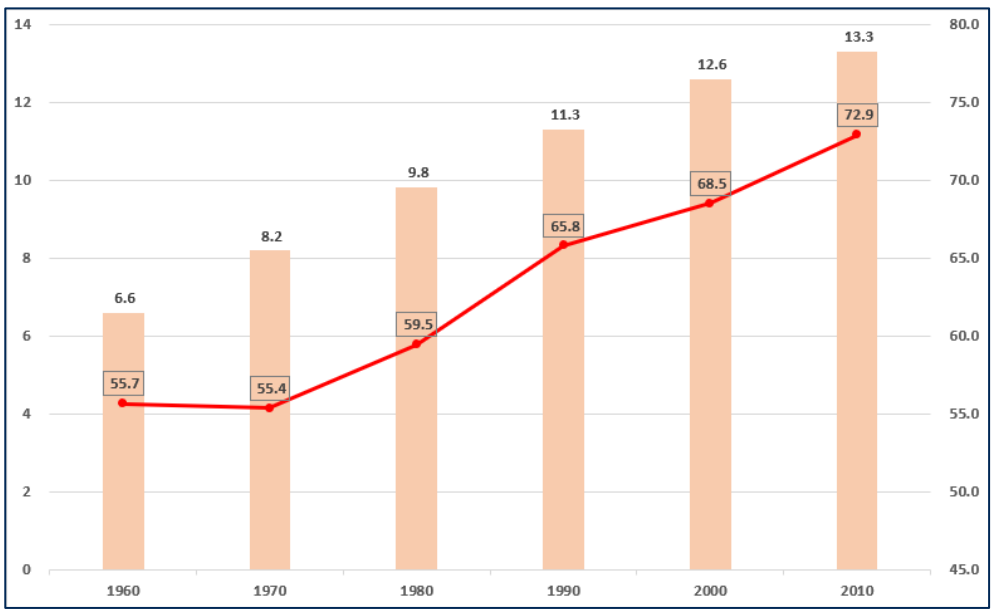
3.1 Labor as Key Production Factor

China had rapid economic growth through an export-oriented economy, mainly contributed by the solid labor-intensive manufacturing sector with the increase in the working-age population. It was the leading industry for export-oriented economic development. For instance, the share of labor-intensive secondary industries in China's annual GDP rose sharply in the 1980s. Moreover, the open-door policy of 1978 and the coastal development strategy in the 1980s enhanced the growth of FDI in China. Thus, China achieved export-oriented economic development by maintaining an increase in the working-age population with low labor costs as well as utilizing overseas capital investment.

3.1.1 Labor-intensive Secondary Industry with High Working-Age Population

The high proportion of the working-age population catalyzed the development of labor-intensive secondary industries with low labor costs. China maintained a high working-age population ratio of over 60% in the 1980s based on the rapid increase in the total population followed by the previous birth encouragement policy. Moreover, before China implemented the one-child policy, its rapid population growth promoted the increase in the working-age population, which resulted in economic development based on the manufacturing sector with low labor costs. Until 2010, the proportion of the working-age population out of the total population continued to grow rapidly from 55.7% in 1960 to 72.93% in 2010.

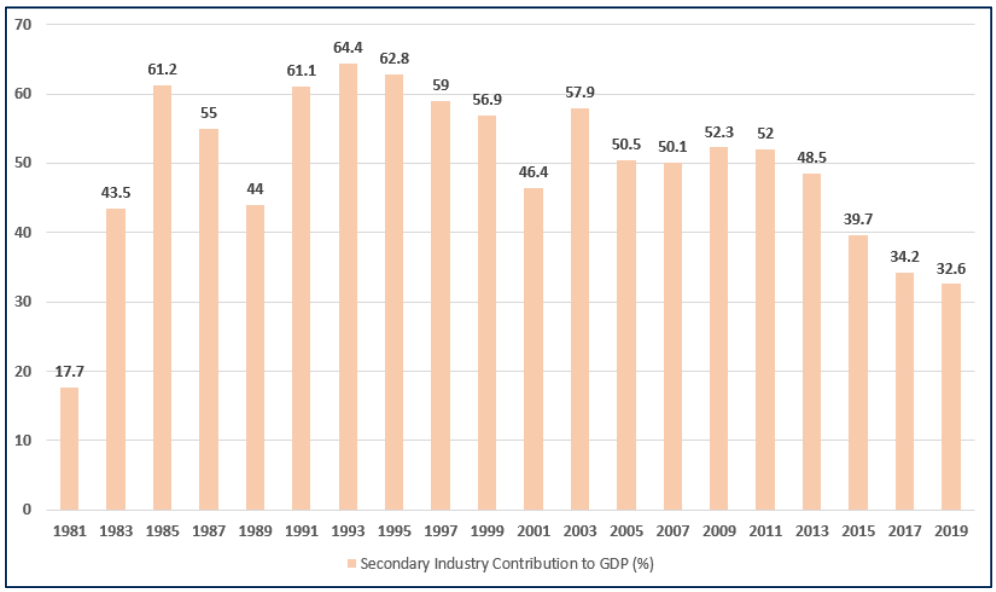
<Figure 1.> Changes in the Working-age Population and the Total Population of China (1960-2010) (in 100 million, %)



Source: WorldBank, World Development Indicators, modified by the author.

Especially, the proportion of the working-age population was less than 60% of the total population until 1980, but the working-age population peaked in 2009 at 72.94%, which was more than 10% over the past 30 years. Meanwhile, the share of labor-intensive secondary industries, such as manufacturing and construction sectors, in China's annual GDP rose sharply in the 1980s, which escalated economic growth. In addition, the share accounted for an annual average of 45.3% in the 1980s and maintained an average of 59.5% and 51.6% in the 1990s and 2000s, respectively. The growth of the manufacturing sector, along with the east coastal development and open economy policies, stimulated export-oriented economic development.

<Figure 2.> Annual GDP Share of China's Secondary Industry (1981-2019) (in %)



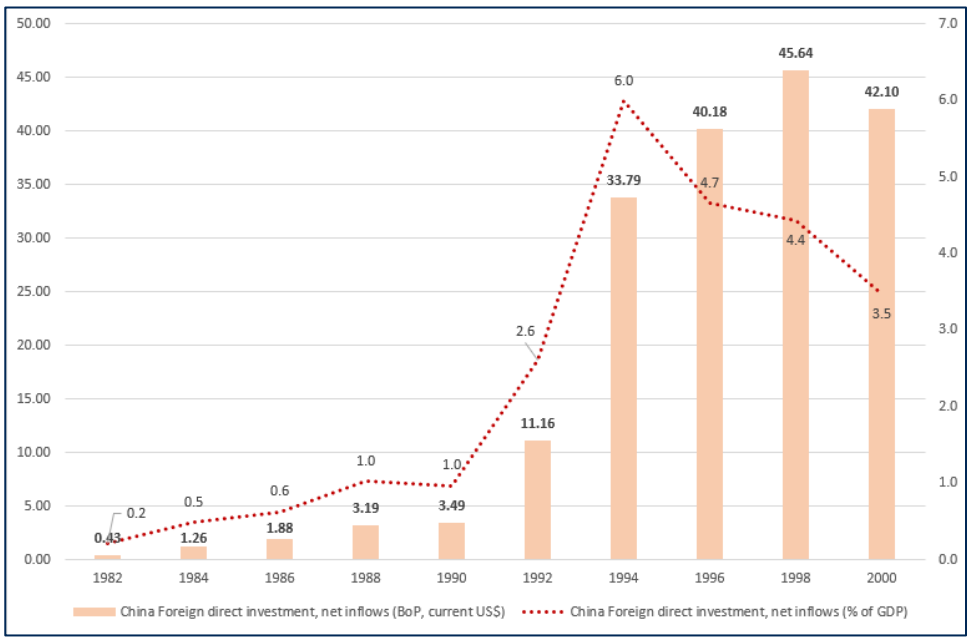
Source: National Bureau of Statistics of China, China Statistical Year Book, modified by the author.

3.1.2 Export-oriented Economic Development through FDI

The era of high-speed economic growth from the 1980s to the 2000s was mainly led by export-oriented economic development, mainly based on the solid labor-intensive secondary industry and excessive flow of FDI. China has promoted export-oriented industrialization based on cheap production factors such as land and labor costs. In the 1980s, China implemented the strategy of "Two Heads Outside (兩頭在外)", which implies that both investment and markets for the manufacturing sectors are in foreign countries. At the meantime, foreign private companies from developed countries were seeking countries with cheap and abundant labor forces due to the rising wages in their own countries. Consequently, China was able to gain the benefit of capital investment and commodity flows through the excessive amount

of FDI.[7] For instance, the net inflows of FDI accounted for 1.26 billion dollars in 1984, and it surged to 33.79 billion dollars in 1994. The proportion of FDI net inflows to the GDP also increased in the same period, respectively from 0.5% to 6%.

<Figure 3.> Growth of FDI inflows in China (1982-2000) (in billion dollars, %)



Source: WorldBank, World Development Indicators, modified by the author.

Therefore, the labor-intensive manufacturing industry based on China's cheap labor cost was selected as the best blue ocean for overseas investment, which ultimately enhanced the export-oriented economy. In the 1980s, followed by China's coastal development strategy, Chinese and foreign companies expanded their

[7] Kueh (1992). "Foreign Investment and Economic Change in China", *Journal of the China Quarterly*, Cambridge University Press, Vol.131, p.643.

manufacturing base in the east coast region of China.[8] Moreover, through the open-door policy of 1978, China reduced the trade barriers to foreign countries, and encouraged investment and export. Through the low labor cost and attractive flow of FDI, the production of the manufacturing sector was increased, and China was able to pursue an export-oriented economy, while achieving the title of the world's factory.

3.1.3 Moving Forward to Develop the Domestic Consumption Market

China's economy entered a new turning point in the 2000s. After the global financial crisis in 2008, China's exports declined significantly due to the recession in overseas markets, especially in developed countries, which directly affected export-oriented manufacturing sectors. The following economic recession led Chinese economic policies to focus more on promoting the domestic market. In the process of recovering from the global financial crisis, China implemented policies to foster the domestic consumption market and announced various support policies to offset the decline in the size of exports through the expansion of the domestic market.[9] Meanwhile, the domestic market was continuously reorganized based on

[8] Zhang (2015). "Is China's Economic Growth Sustainable? A General Equilibrium Analysis", *Journal of Developing Areas*, Vol.49 (4), p.408, also stated, "With an annual growth rate of around 10% in real terms over more than three decades between 1979 and 2012, China has become the largest exporter, the largest holder of foreign exchange reserves, the largest destination of foreign direct investment and the second largest economy in the world."

[9] Ibid. p.408, stated, "As a result of a significant slowing down in external demand, the Chinese authorities have started to switch China's development strategy from export-orientation toward

the increase in international standards, and incorporated into the global market order following the WTO accession at the end of 2001. With the purchasing power of a population of 1.4 billion, nowadays, China's economic development is based on 'dual circulation', which is driven by both exports and domestic consumption.[10] In other words, 'export-oriented' driven by FDI, and 'consumption' by a population of 1.4 billion within the domestic market worked as dual kinetic energy to promote China's economic growth.

domestic market promotion, particularly on boosting domestic consumption through carrying out further economic reforms at home."

[10] Lin (2021). "Dual Circulation and China's Development", *Frontiers of Economics in China*, Higher Education Press, Vol.16 (1), pp.31-32, "As the world's largest trading nation, China will definitely experience reduction in exports, which means that its domestically-made products will have to be increasingly absorbed domestically, namely, domestic circulation."

3.2 Demographic Bonus Argument

The demographic bonus trend positively affected to China's economic development since most of production labor was mainly done by human resources. Also, China's demographic bonus, along with low total dependency ratio and labor cost, was a major contribution factor to production-oriented economic development. The one-child policy positively affected economic growth by reducing the youth dependency ratio[11] and maintaining a low total fertility rate. It also stimulated economic growth by reducing child support expense, and increasing savings and investment. China's demographic bonus, led by both the rapid increase in the working-age population, indicated the excessive growth of the production-oriented economic development with low labor costs.

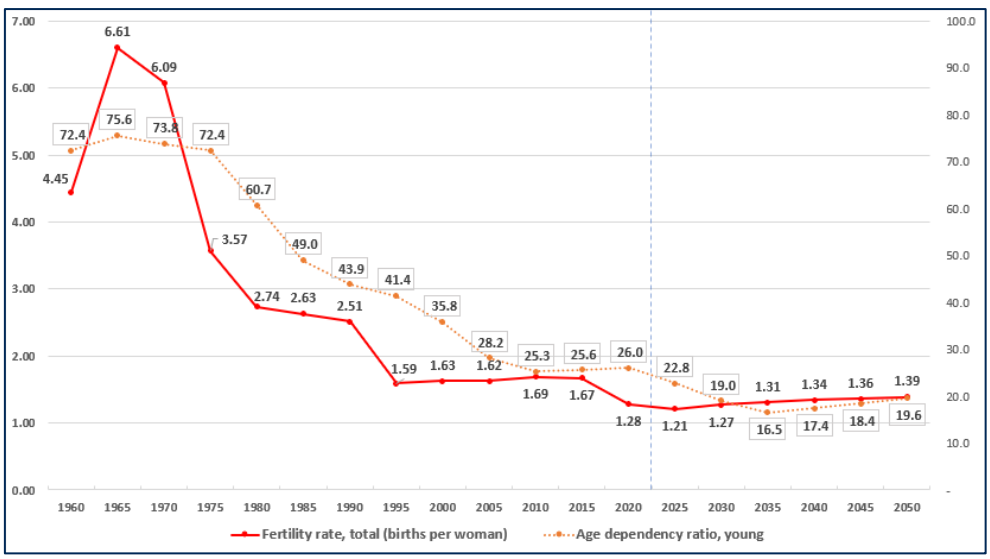
Based on the demographic bonus, China's economic growth was gradually increased through low-wage and labor-intensive secondary industries such as the manufacturing sector. Meanwhile, due to the birth control policies, a low percentage of the youth dependency ratio was maintained, which enhanced economic growth by increasing savings and investment by reducing child support costs. The demographic bonus itself does not directly boosts economic growth. Instead, appropriate economic policies must be also accompanied. For instance, the economic reforms in the 1980s had a synergy effect with the demographic bonus to boost economic

[11] The youth population (ages 0 to 15) divided by the working-age population (ages 16 to 64) x 100. Also, the Old-age Dependency Ratio is the senior population (ages over 65) divided by the working-age population (ages 16 to 64) x 100.

development, which was led by the productive labor force and the excessive flow of FDI in east coastal areas.

3.2.1 The Effect of One-Child Policy to the Youth Dependency Ratio

<Figure 4.> China's Total Fertility Rate and Youth Dependency Ratio (1960-2050) (in person, %)



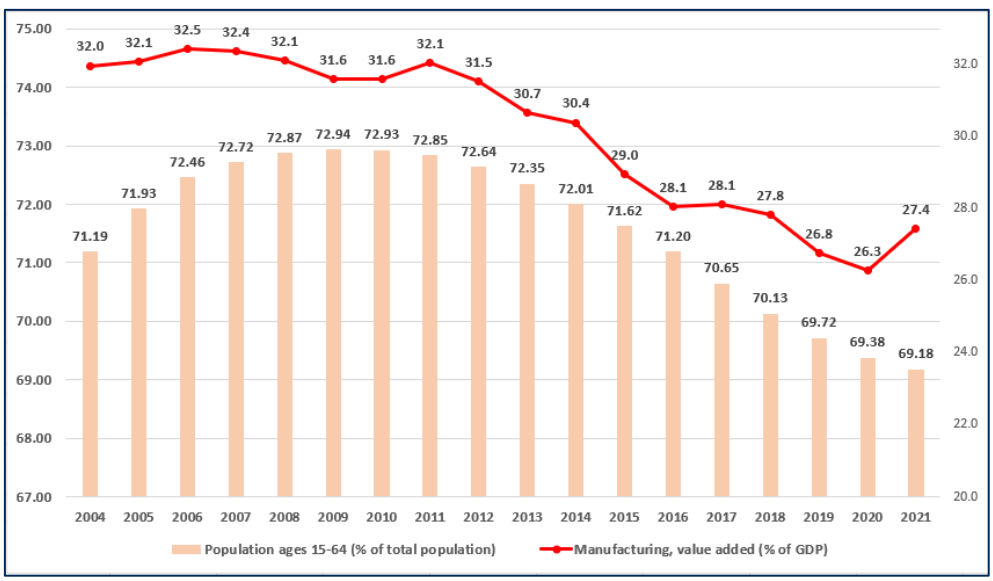
Source: WorldBank, World Development Indicators, modified by the author.

China developed a labor-intensive secondary industry by utilizing an open-door policy and maintaining a high working-age population. In the meantime, through the implementation of the one-child policy, the youth dependency ratio has decreased due to the low total fertility rate. It also stimulated economic growth along with the economic policies by reducing child support expense, and increasing savings and investment.

The trend of total fertility rate had a sharp decline over the 10 years from 1970, when China's birth control policy began, to 1980. After 1991, it continuously maintained an average of less than two. Likewise, as the total fertility rate declined, China's youth dependency ratio began declining after peaking in 1965 at 75.6%. In particular, it represented 43.9% in 1990, showing a sharp decrease of 16.8% compared to 60.7% in 1980. As a result, the one-child policy positively affected economic growth by reducing the youth dependency ratio.

3.2.2 A Correlation in between Working-Age Population and Labor-intensive Industry

<Figure 5.> The Working-age Population and Manufacturing, value added (% of GDP) (in %)



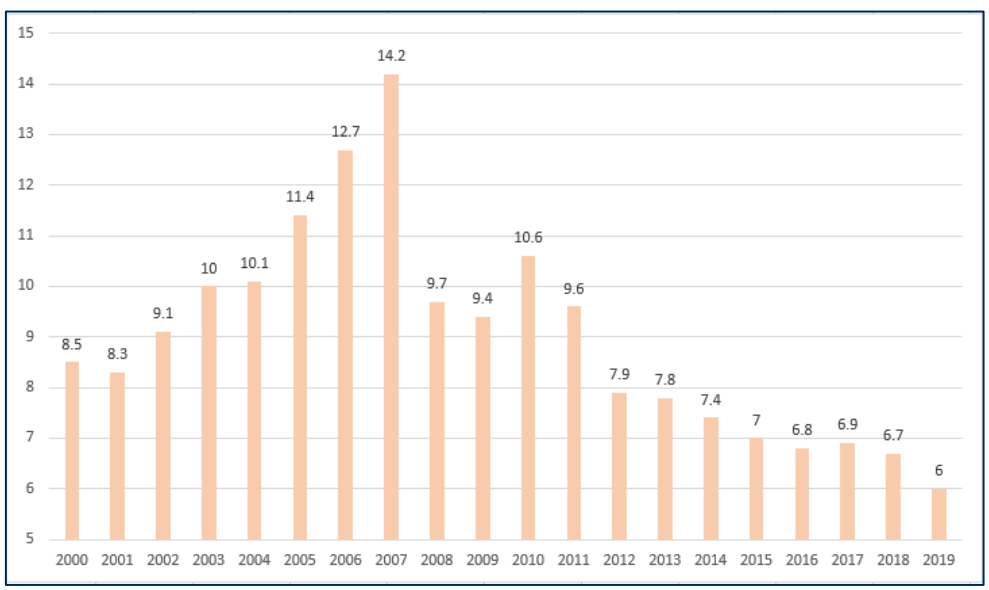
Source: National Bureau of Statistics of China, China Statistical Year Book; World Bank, World Development Indicators, modified by the author.

The proportion of the labor-intensive industry in GDP had rapidly increased with a high working-age population for thirty consecutive years. On the other hand,

the rising trend of China's working-age population had its peaked in 2009 at 72.94%, and has been steadily declining since 2010. Meanwhile, among the secondary industry, the value-added share of manufacturing to GDP had a steady decline. The share of manufacturing value-added in annual GDP has continuously declined from 2011 to 2020, respectively from 32.1% to 26.3%.

There is no direct correlation between the decline in the working-age population and the downturn in the share of the manufacturing industry in GDP. Although there is no causal relationship, the period in which the decreasing trend of the working-age population is in line with that of a declining share of labor-intensive secondary industry in GDP.

<Figure 6.> China's annual GDP growth rate (in %)



Source: WorldBank, World Development Indicators, modified by the author.

During this period, China's economic growth based on the labor-intensive manufacturing sector faced a new challenge while overcoming the global financial crisis after 2008. Unlike the previous high-speed growth, China’s economic growth has gradually continued with medium-speed growth, so-called the “New Normal” phenomenon. Through positive effects such as demographic bonus and accession to the WTO in 2001, China's GDP growth has rapidly increased from 8.5% in 2000 to 14.2% in 2007. After reaching its peak in 2007 at 14.2%, however, it has continued to grow moderately.

IV. New Challenges to China with Demographic Change

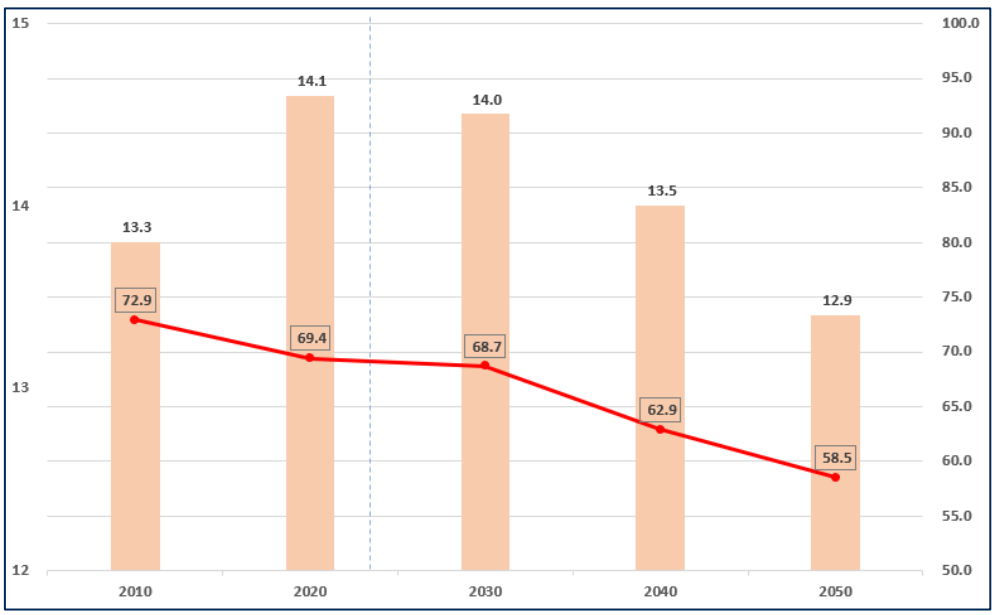
4.1 Demographic Onus Argument

China's old-age dependency ratio is rising faster than the declining of youth dependency ratio, which may negatively impact economic development. China's working-age population had continued to grow until 2010 by 72.93%, but expected to drop to 58.5% in 2050. Meanwhile, China's total dependency ratio is expected to increase due to the rising old-age dependency ratio. Also, the decline in the total fertility rate due to the continuous one-child policy could further aggravate the overall decline in the working-age population and population aging. Hence, the following phenomenon may act as a burden, which could indicate a downturn in economic growth by various factors such as low labor productivity, a decrease in house saving rates, and increase in tax expenditure by social welfare and health care. Overall, China should seek for the new driving force to enhance economic development along with the demographic transition.

4.1.1 Decline in the Proportion of Working-age Population

Over the past 30 years, China achieved rapid economic growth mainly based on developing the labor-intensive secondary industry through the demographic bonus with the increase in the working-age population, which continued until 2010. In the meantime, it was possible to maintain a low youth dependency ratio through a decrease in the total fertility rate under the birth control policy, which had a positive effect on economic growth.

<Figure 7.> The Projection of the Working-age Population and the Total Population of China (2010-2050) (in 100 million, %)



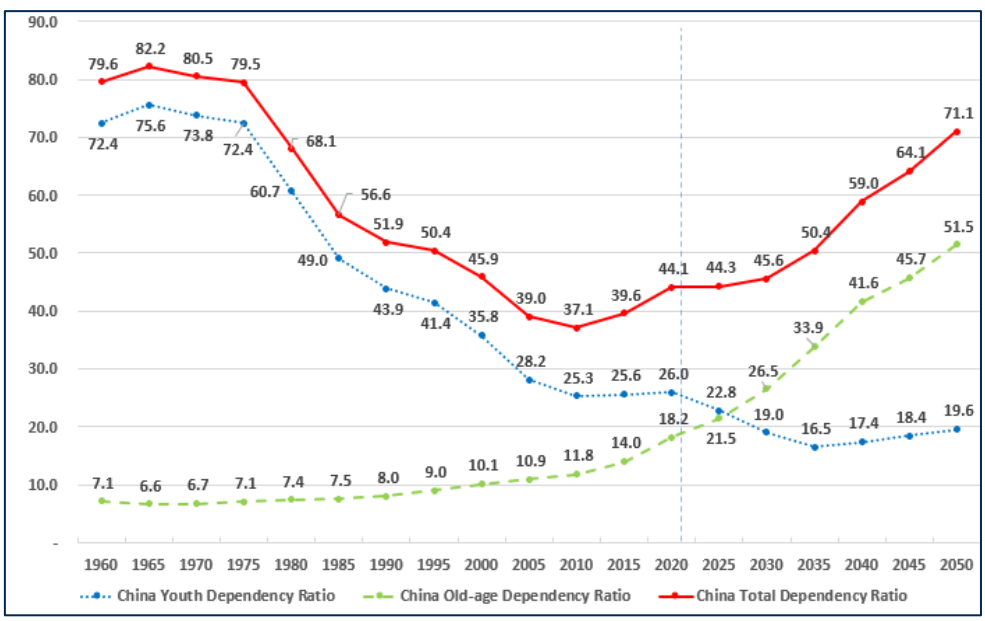
Source: WorldBank, World Development Indicators, modified by the author.

In contrast, the proportion of China's working-age population is projected to be decrease due to the decline in the total fertility rate. In other words, the demographic bonus driven by a large working-age population could be changed as the demographic onus trend, which may negatively impact to economic growth. China's working-age population had a peak size of 72.93% in 2010. However, it is projected to drop to 58.5% by 2050, with a decrease in the total population to 12.9 billion.

4.1.2 Increase of the Total Dependency Ratio

In most of developing countries, usually the youth dependency ratio is relatively higher than the old-age dependency ratio due to the high fertility rate. Such a high youth dependency ratio, however, delivered a negative impact on economic growth and development because it is a burden on the working-age population as well. In terms of the following reason, China also managed child support expenses by regulating the total fertility rate for a long time by implementing of birth control policies. Meanwhile, China maintained steady economic growth while keeping the total dependency ratio at a low level.

<Figure 8.> The Projection of the Total Dependency Ratio of China (1960-2050) (in %)



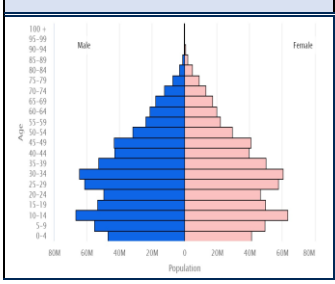
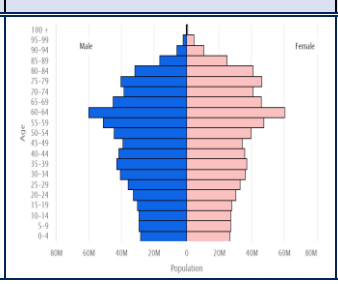
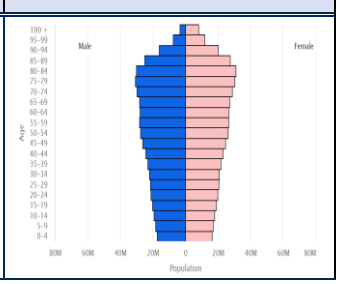
Source: WorldBank, World Development Indicators, modified by the author.

By 2027, however, the proportion of the old-age dependency ratio in China

is expected to be higher than the youth dependency ratio. The increase in the old-age dependency ratio, which is rising more steeply than the decline in the youth dependency ratio, could cause social and economic problems and ultimately hinder economic growth. China maintained a consistently high youth dependency ratio until 1970. For instance, a high level of over 70% from 1970 to 1975, 73.8% and 72.4% respectively, was preserved. Then, the ratio showed a clear downward trend starting in 1980 at 60.7%, and it was consistently below 30% after recording 35.8% in 2000.

On the other hand, the old-age dependency ratio maintained less than 10% until 1999 as of 9.9%, but has increased faster than the past, reaching 18.2% in 2020. Starting from 2027, the proportion of the old-age dependency ratio will be higher than that of the youth dependency ratio of 21.1%. If the current trend continues, the old-age dependency ratio of China could reach up to 51.5% in 2050.

<Table 2.> Projections for the Population Pyramid of China

2000	2050	2100
		

Source: U.S. Census Bureau, International Database

In general, population pyramid of China could gradually change from 2000 to 2100. The following prediction may be differed by the change of variables such as future birth-related policies, but the prediction at this point is listed as the table above. Most of the western developed countries took around a hundred years to

become the aging society and, according to the aging standard classified by the UN, China has already entered an aging society by exceeding 7%.[12] The population aging is a concern that not only China, but also other East Asian countries like South Korea and Japan also need to keep deal with.

4.1.3 Socio-economic Implications

Economically, various economic factors could be modified due to the demographic transition. For example, a decrease in the working-age population indicates a decrease in labor productivity and an increase in the tax burden, which may lead to a downturn in economic growth. In addition, the expansion of the population-aging could negatively impact on a decline in the household savings rate due to economic burdens such as rising expenditure for health care and pensions.[13] Also, the following trend may obstruct the financial viability of the social-security systems such as nursing, medical care, pensions and insurance, etc.[14] Therefore, the following trend may increase economic burdens to the working-age population since they may take in charge of both the cost of supporting the older generation in line with the savings for preparing for their own retirement plan. Consequently, both a

[12] Chung (2018). "Analysis of the Effects of China's Population Aging on the Macroeconomic Variables", *Korean Management Consulting Review*, Vol.18 (1), p.311.

[13] Economist Magazine (2023). "It's not just a Fiscal Fiasco: Greying Economies Also Innovate Less", The Economist (2023.05.30).

[14] Gruber and Wise (1998). "Social Security and Retirement: An International Comparison", *The American Economic Review*, Vol.88 (2), p.158.

decrease in the working-age population and the population-aging concern could hinder economic growth.

Moreover, along with the demographic transition, the consumption pattern of people is changing mainly due to rapid economic growth and improvement in the income level. The previous consumption pattern was focused on livelihood. Nowadays in China, however, the trend has steadily shifted to more on that of the culture, education, and entertainment sectors.[15] According to the National Bureau of Statistics of China, the consumption structure of China's urban population can be divided into eight different categories.[16] Among them, consumption expenditure related to the health care and medical services has increased excessively mainly due to the population aging.[17] Due to the increase in average life expectancy by the development of medical technology, the medical expenses of the old-age population are also rapidly increasing. For instance, the health care and medical services expenditure per capita in Chinese urban residents was less than 100 yuan between 1985 to 1990. Then, it increased steeply up to 318 yuan in 2000, which was 155.1 times that of 1985. As China's population aging trend is expected to continue to

[15] Seo et al. (2020). "A Study on the Consumption Structure due to Population Change in China", *Journal of Asian Studies*, Vol.23 (3), p.231.

[16] The eight different categories of consumption described by the National Bureau of Statistics of China: Food, Tobacco and Liquor; Clothing and Footwear; Housing; Household Equipment, Furnishings and Services; Transportation and Communications; Education, Culture and Recreation; Health Care and Medical Services; Miscellaneous Goods and Services.

[17] Seo et al. (2020), p.233.

accelerate, the health care and medical services related expenditures are also expected to increase continuously.

In addition, the education, culture, and recreation-related expenditure per capita in Chinese urban residents increased 55.5 times between 1985 to 2022. Due to China's declining total fertility rate, the proportion of the youth population (under the age of 15) continues to decline. However, as the education market develops due to the high enthusiasm of the Chinese people for education, expenditure on the education sector is expect to be keep increase steadily. Likewise, as of 2020, the number of people with a bachelor's degree per 100,000 people increased from 8,930 to 15,467 compared to 2010, and the average years of education for the population aged 15 and above increased from 9.08 to 9.91 years.[18]

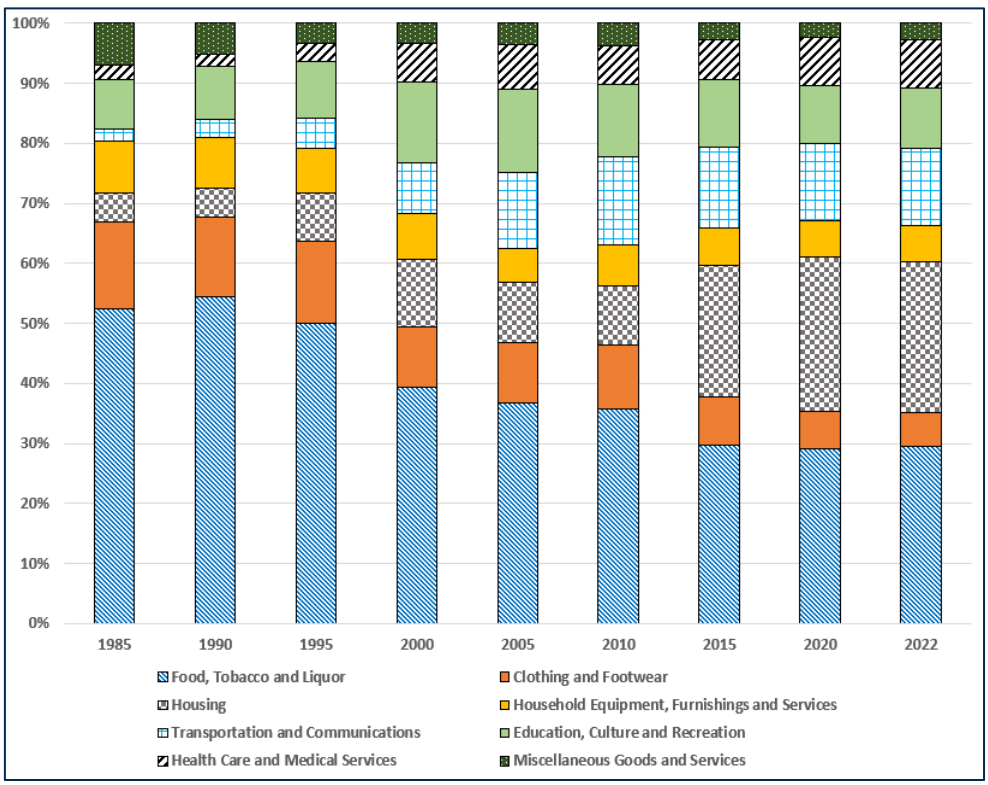
[18] Korea Institute for International Economic Policy (2021). "Main Contents and Prospects of China's 7th Census", Vol.23 (4), p.7.

<Table 3.> Per Capita Consumption Expenditure of Urban Households (1985-2022) (in yuan, %)

Year	Total	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
1985(a)	670	351	98	32	57	14	55	16	47
1990	1,274	693	170	60	108	40	112	25	66
1995	3,535	1,772	479	283	263	183	331	110	114
2000	4,995	1,971	500	565	374	427	669	318	171
2001	5,307	2,014	533	548	438	457	690	343	284
2002	6,026	2,271	590	624	388	626	902	430	195
2003	6,508	2,416	637	699	410	721	934	476	215
2004	7,178	2,709	686	733	407	843	1,032	528	240
2005	7,938	2,914	800	808	446	996	1,097	600	277
2006	8,693	3,111	901	904	498	1,147	1,203	620	309
2007	9,995	3,628	1,042	982	601	1,357	1,329	699	357
2008	11,239	4,259	1,165	1,145	691	1,417	1,358	786	418
2009	12,260	4,478	1,284	1,228	786	1,682	1,472	856	474
2010	13,468	4,804	1,444	1,332	908	1,983	1,627	871	499
2011	15,158	5,506	1,674	1,405	1,023	2,149	1,851	969	581
2012	16,671	6,040	1,823	1,484	1,116	2,455	2,033	1,063	657
2013	18,484	5,570	1,553	4,301	1,129	2,317	1,988	1,136	490
2014	19,965	6,000	1,627	4,489	1,233	2,637	2,142	1,305	532
2015	21,389	6,359	1,701	4,726	1,306	2,895	2,382	1,443	577
2016	23,074	6,762	1,739	5,113	1,426	3,173	2,637	1,630	594
2017	24,442	7,001	1,757	5,564	1,525	3,321	2,846	1,777	651
2018	26,110	7,239	1,808	6,255	1,629	3,473	2,974	2,045	687
2019	28,063	7,733	1,832	6,780	1,689	3,671	3,328	2,283	747
2020	27,008	7,881	1,645	6,958	1,640	3,474	2,592	2,172	646
2021	30,307	8,678	1,843	7,405	1,820	3,932	3,322	2,521	786
2022(b)	30,391	8,958	1,735	7,644	1,800	3,909	3,050	2,481	814
b/a	**45.4**	**25.5**	**17.7**	**238.9**	**31.6**	**279.2**	**55.5**	**155.1**	**17.3**

Source: Seo et al. (2020), pp.235-236; National Bureau of Statistics of China, China Statistical Year Book (2022); (A) Food, Tobacco and Liquor; (B) Clothing and Footwear; (C) Housing; (D) Household Equipment, Furnishings and Services; (E) Transportation and Communications; (F) Education, Culture and Recreation; (G) Health Care and Medical Services; (H) Miscellaneous Goods and Services.

<Figure 9.> Changes in the Structure of Consumption Expenditure Per Capita in China's Urban Population (1985-2022) (in %)



Source: Seo et al. (2020), p.235; National Bureau of Statistics of China, China Statistical Year Book (2022).

Moreover, the share of food expenditure had continuously decreased compared to the past when it was mainly for subsistence consumption. According to the announcement of the National Bureau of Statistics of China, the Engel coefficient of China in 2021 is 29.8%, which is still higher than Korea and Japan, respectively

12.8% and 16.3%.[19] However, it is noteworthy that the coefficient was less than 30% for the first time in 2021. As a result, the decrease in the Engel coefficient represents a relatively high increase in selective consumption for entertainment and intellectual consumption for self-development (overseas travel, movies, etc.). The following trend seems to be due to the improvement of living standards, expansion of the middle class, and rise in income.

Therefore, it is necessary to seek a new driving force for economic growth through industries and services that reflect consumption patterns in line with demographic changes in the future. Although demographic onus could adversely affect economic growth by increasing the total dependency ratio, reducing household savings, and increasing government spending, the impact could be minimized by creating a new stimulus with high-technology-intensive development rather than rely heavily on the than labor-intensive secondary industry.

[19] National Bureau of Statistics of China (2022). "Statistical Communiqué of the People's Republic of China on the 2021 National Economic and Social Development", (February, 2022).

4.2 Digital Transformation and Economic Development

The 21st century is so-called ‘the Era of the 4th Industrial Revolution’ that digital transformation and technological development are applied to various industries and act as a new mechanism for economic development. For example, consumers may order products through E-Commerce with a few clicks on their mobile phones. Also, using self-check-in system through electronic kiosks is gradually rising as a common rule in airports and movie theaters rather than directly dealing with the employee. In addition, it is more convenient to transfer money through the online banking system and saves time, which led to the decreasing number of offline bank branches. Also, the efficiency of the working process is increasing in restaurants, even with a smaller group of employees through digital transformation.

In other words, digital transformation phenomenon is a new key factor to consider while evaluating the correlation in between demographic changes and economic development. Moreover, digital transformation through the development of Smart (AI) industries could neutralize the negative impact of the demographic onus trend to economic development by surging both the efficiency of the supply side and convenience of the demand side. Through digital transformation, entrepreneurs could maximize profit by increasing the efficiency of the working process with less labor force while providing more accurate and prompt services to the customers. Overall, digital transformation and technological advances in both supply and demand could enhance the positive impact on economic development.

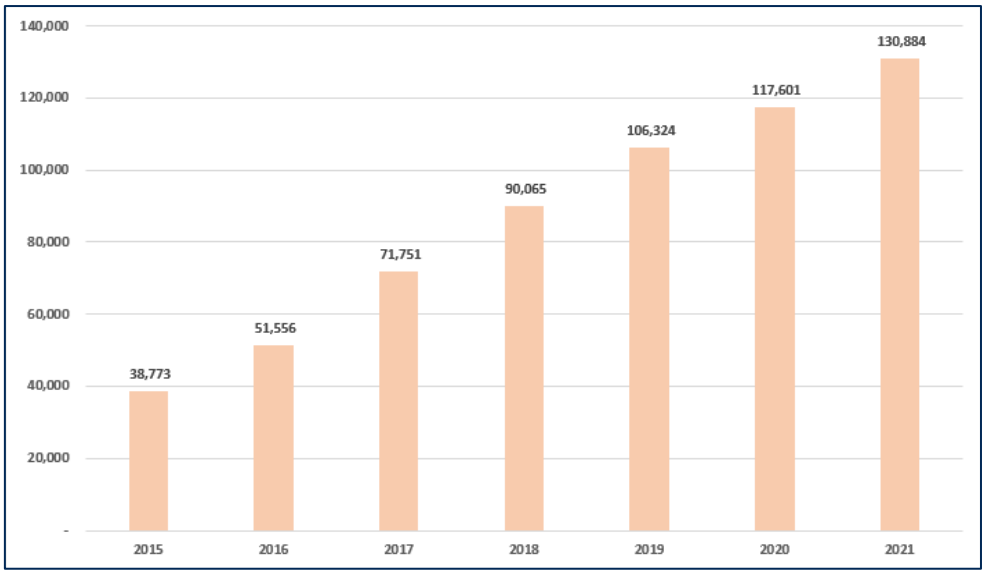
Therefore, in the era of the 4th industrial revolution, it is uncertain to assure whether the demographic bonus has a positive effect or the demographic onus has a negative effect on economic development. At least, digital transformation and technological development could stimulate efficiency and convenience in both supply and demand side, which could offset the negative impact of a decrease in the working-age population.

The development of the internet-related industries was a leading factor in digital transformation in the 2000s. Then, the expansion of smart (AI) industries is now a significant factor in boosting digital transformation and acting as a driving force for economic development. The indicators of economic development become more diverse through digital transformation with the rise of AI technology compared to only driven by the internet in the 2000s. Digital transformation phenomenon through the expansion of AI-related industries, however, could be a two-sided coin since it could be critical to labor-intensive industries like manufacturing sectors by losing jobs. In contrast, the growth of newly rising smart industries led by AI and robotics technologies could offset the economic downturn caused by the lack of a working-age population.

4.2.1 Increase of the Online market through the development of the Internet

From the 2000s to the present, the development of the Internet has created new industries, such as the online retail market. The size of China's online retail market has continued to increase rapidly. For instance, the size of China's online retail sales market has more than tripled from 3.8 trillion yuan in 2015 to 13 trillion yuan in 2021.

<Figure 10.> China's Online Retail Sales Value (2015-2021) (in 100 million yuan)

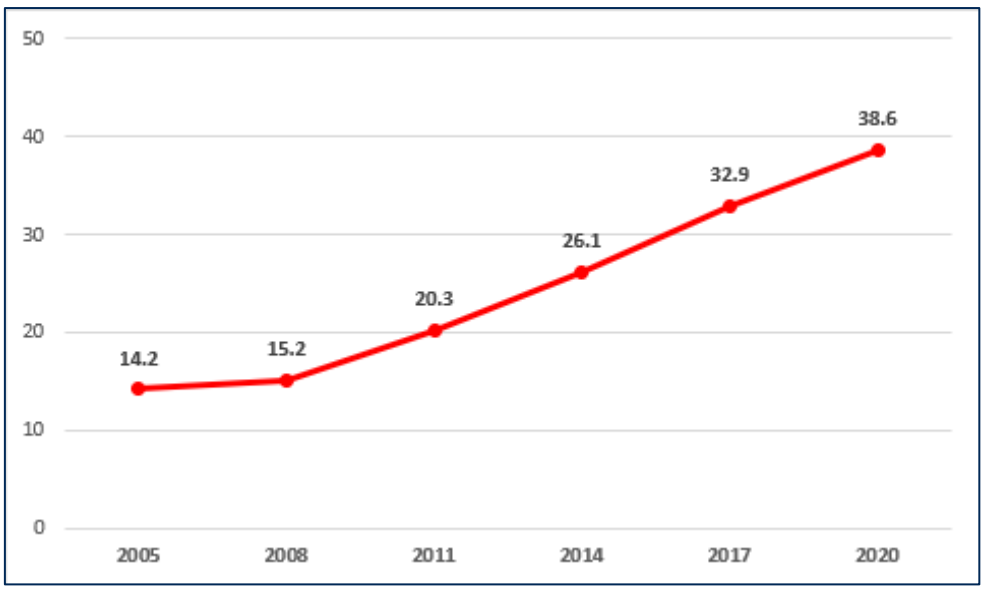


Source: National Bureau of Statistics of China, China Statistical Year Book, modified by the author.

Moreover, the global pandemic due to the COVID-19 affected the increase of demand in the online retail sales market due to the quarantine and restricted circumstances, especially in China.[20] In addition, the robot and smart (AI) industries also had rapid growth during the pandemic, along with the internet. Therefore, digital economy led by the development of the internet is now increasing its pie with the emergence of AI. Although demographic onus could adversely affect economic growth by increasing the total dependency ratio, reducing household savings, and increasing government spending, the impact could be minimized by creating new leading industries through smart-intensive development.

[20] UNCTAD (2020). "Estimate of Global E-Commerce 2019 and Preliminary Assessment of COVID-19 Impact on Online Retail 2020", UNCTAD Technical Notes on ICT for Development, p.1.

<Figure 11.> China's Proportion of Digital Economy in GDP (2005-2020) (in %)



Source: China Academy of Information and Communications Technology (2020), modified by the author.

In fact, various existing industries are now transforming more 'smarter' through the development of AI technology and robots. The 'smartization' of these industries is filling the blanks of the economic development caused by the decline in the working-age population, following the demographic cliff trend. For instance, customers could grab a taxi or order food through their mobile apps rather than communicate with the workers via phone calls.

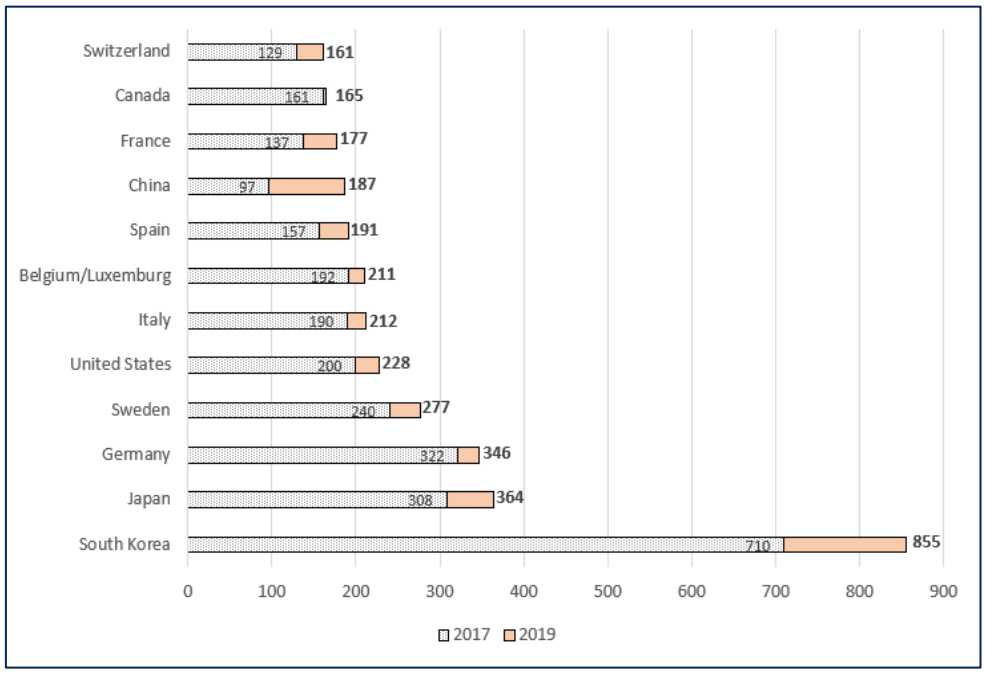
4.2.2 Restructuring from the 'Labor-intensive' to 'Smart-intensive' Manufacturing sector

The labor-intensive industry like the manufacturing sector was essential to enhancing economic growth in the past. Nowadays, however, it is pointed out as the most vulnerable industry to the development of AI and automation technologies. For instance, in 2030, about one-fifth of all labor-intensive manufacturing jobs in China could be replaced with automation by AI and robot technology, which is about 100 million workers.[21] More importantly, the unit labor cost of the manufacturing sector in China has increased by 65% from 2008 to 2019.[22] The rise of wages implies that expanding the proportion of utilizing automation could be more efficient since installing robots for production is becoming cheaper than human resources in the long-term perspective.

[21] Roberts et al. (2020). "The Chinese approach to artificial intelligence: an analysis of policy, ethics, and regulation", *AI and Society*, Vol.36 (1), p.65.

[22] Oxford Economics (2019). "How Robots Change the World. What Automation Really Means for Jobs and Productivity", (June, 2019), p.17, also stated that, "Despite its rapidly growing inventory, China only uses 68 robots per 10,000 workers [2016 data] in general manufacturing, compared with 303 per 10,000 in Japan, and 631 per 10,000 in South Korea. […] Large sections of China's workforce are still engaged in manual process, meaning vast potential remains for further robotization of its manufacturing sector – more so than any other country."

<Figure 12.> The Countries with the Highest Density of Robot Workers
(in one industrial robot per 10,000 employees in the manufacturing industry)



Source: McCarthy (2020).

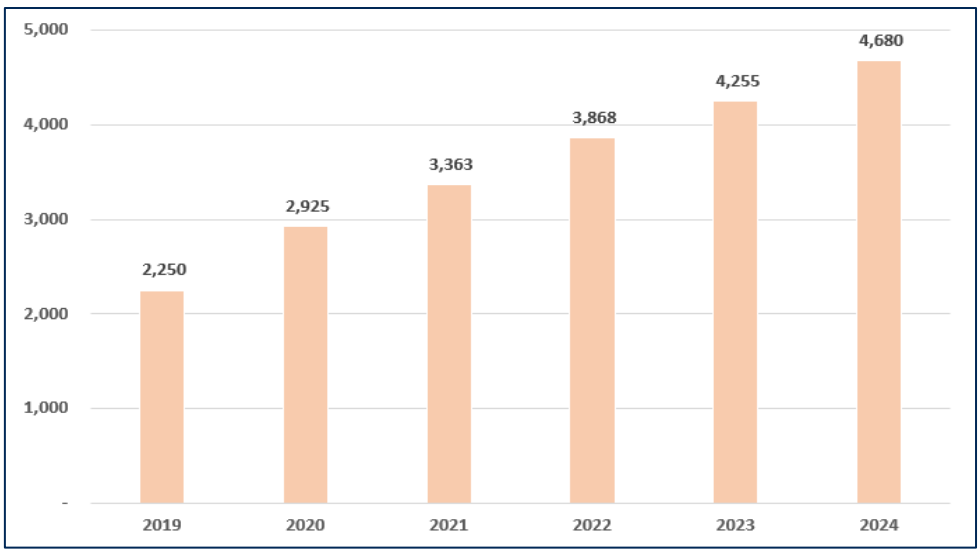
Along with the 4th industrial revolution trend led by the development of smart (AI) and robot technologies, China released specific objectives related to the development of smart-manufacturing sector through the 14th Five-Year Plan in 2021. It stated that,

> *"Digitization Transformation Projects in the Manufacturing Sector […] Deeply advance smart manufacturing development […] Research and develop applied technologies for application in industrial sectors based on artificial intelligence, 5G, blockchain, etc. Promote research, development, and iterative upgrading of critical equipment in smart*

manufacturing; encourage the research and development of smart manufacturing equipment suites aimed at specific sectors." [23]

The plan's objective is mainly focusing on smartization of the manufacturing industry, which is expected to be a new mechanism to the economic growth in the future rather than labor-intensive strategy mainly led by the demographic bonus. China's smart-manufacturing industry is expected to grow from 2,925 billion yuan in 2020 to 4,680 billion yuan in 2024. As the labor-intensive industries with an abundant working-age population aid to export-oriented economic development in the past, the smart-intensive innovation is rising as a new driving force nowadays.

<Figure 13.> China's Smart-Manufacturing Market Size (2019-2024) (in billion yuan)



Source: China Academy of Information and Communications Technology (2020), modified by the author.

[23] Creemers et al. (2022). "Translation: 14th Five-Year Plan for National Informatization – Dec. 2021", Stanford University Cyber Policy Center (January, 2022)

4.2.3 Development of 'Smartization' with Digital Transformation

The smartization phenomenon driven by the development of AI and robots is not only progressing in the labor-intensive manufacturing sector, but also in every industry broadly. As the trend of robots and automation replacing humans is growing, the proportion of utilizing service robots is gradually increasing in China in various industries such as hospitality, retail and health care, etc. The Chinese government also expressed the following intention to enhance its economic growth by adopting "Internet Plus" and "Made in China 2025" plans in 2015, which reflects the development of existing industries with robot, big-data and smartphone technologies.[24] Likewise, the State Council of China released the "New Generation Artificial Intelligence Development Plan" (AIDP) in 2017, which contains strategic objectives related to the AI industries. According to the AIDP, the State Council of China officially remarked AI as a new key factor to the future economic development. It stated that,

> *"AI has become a new engine of economic development. AI has become the core driving force for a new round of industrial transformation, [which] will advance the release of the huge energy stored from the previous scientific and technological revolution and industrial transformation, and create a new powerful engine, reconstructing production, distribution, exchange, consumption, etc. […] must accelerate the rapid application of AI, cultivating and*

[24] Ernst (2016) "Advanced Manufacturing and China's Future for Jobs", East-West Center Working Papers, Innovation and Economic Growth Series, No.8, (August 2016), p.7

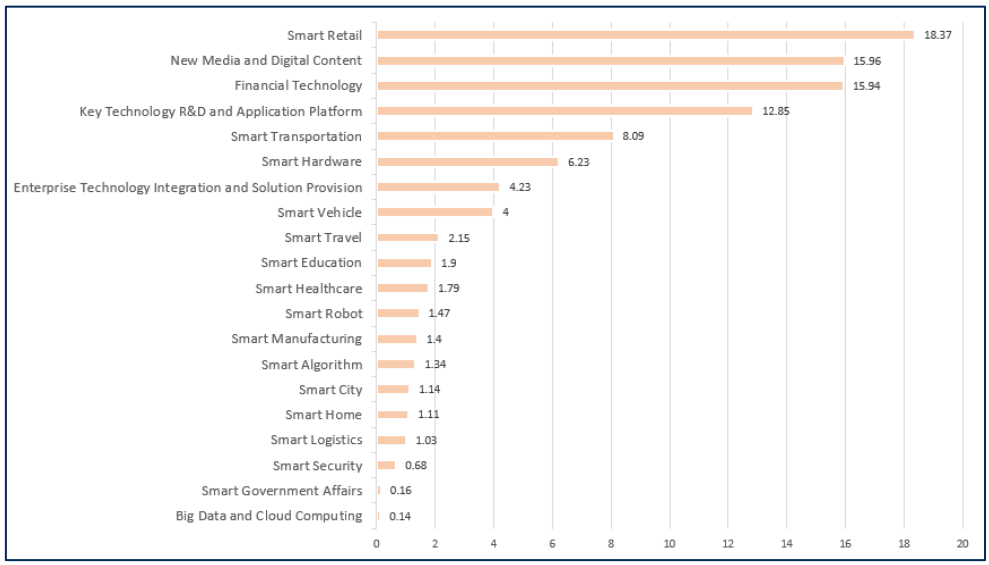
expanding AI industries to inject new kinetic energy into China's economic development."[25]

As mentioned above, the firm statement by the Chinese Government also highlighted the importance of AI as a new mechanism for economic development. Moreover, the Chinese government actively financially aids multiple enterprises of smart (AI) industries to become a leading country in AI-related industries by 2030. Thus, China actively financing AI-related industries and companies with 383 billion yuan in 2018, which is more than doubled from that of 2017.[26]

[25] Webster et al. (2017). "Full Translation: China's 'New Generation Artificial Intelligence Development Plan' (2017)", Stanford University Cyber Policy Center, (August, 2017), also stated that the strategic objectives of Chinese government are to increase the scale of AI industries up to 1 trillion yuan and become the world-leading country of AI related industries.

[26] Imbrie et al. (2020). "The Question of Comparative Advantage in Artificial Intelligence", CSET Policy Brief, Center for Security and Emerging Technology (January 2020), p.18.

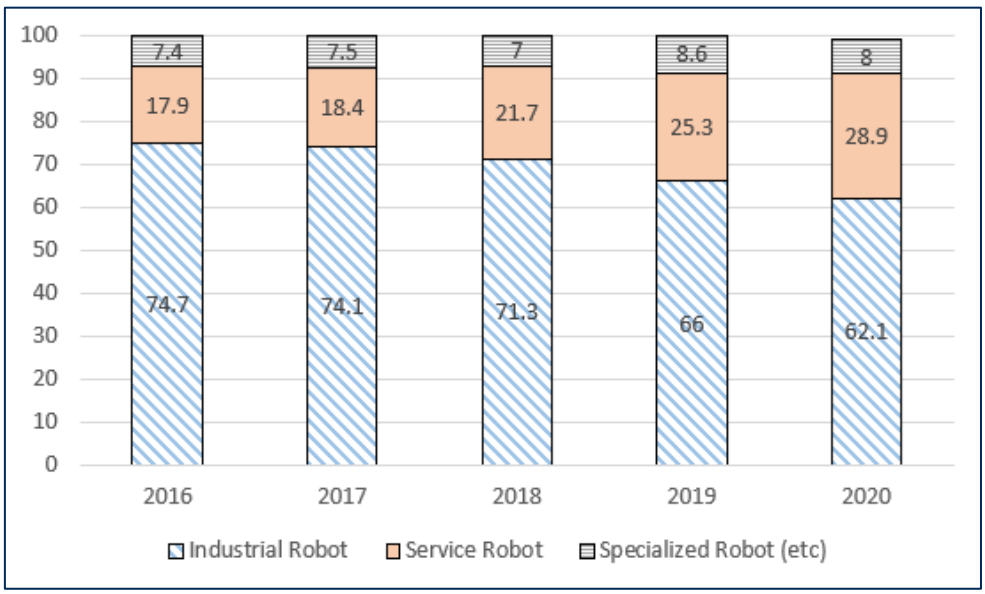
<Figure 14.> Chinese Government Financing Amount Proportion in Smart Industries applied by AI (in %)



Source: Chinese Institute of New Generation Artificial Intelligence Development Strategies (2020).

Although the Chinese government focus on the smart-manufacturing sector, it only covers less than 2% of the total government subsidy to overall smart industries. It reflects that smartization process is progressing in every industry, not only in the smart-manufacturing sector. Thus, the development of smart (AI) industries alleviates the necessity of an abundant working-age population, and acts as an essential factor to consider while analyze the correlation between demographic change and economic development. For instance, the development of service robots provides convenience to customers in various sectors of service industries. Likewise, nursing support-related service robots in the senior care industry may act as an alternative to fulfill the lack of labor force.

<Figure 15.> Market Share of Industrial, Service and Specialized Robots in China (in %)



Source: Slotta (2022).

Interestingly, the market share of service robots is increasing compared to that of industrial robots from 17.9% in 2016 to 28.9 in 2020. On the other hand, it does not mean that the number of industrial robots is decreasing since the total market size of automation by robots as a whole is rapidly expanding.

In addition, there is a certain limitation to adopting service robots in service industries like the senior care and hospitality compared to that of industrial robots. Most of service industries still require altruism, creativity, and various social senses that the automation by robots may not perfectly fulfill.[27] In other words, fewer service-related jobs will be replaced by automation compared to labor-intensive

[27] Oxford Economics (2019), p.7

industries which generally require manual labor. Instead, the efficiency of the working process could be increase in overall by utilizing robots.

V. Conclusion

5.1 Conclusion

China's economic development for past forty years was mainly driven by two key factors such as "Made in China" through the export-oriented economy with labor-intensive industries, and "Sell in China" by the development of its domestic market. Nowadays, through digital transformation, "Smart in China" is rising as a new kinetic energy to carry out the future economic development in the 21st century.

Along with digital transformation led by the development of smart (AI) industries, the demographic onus trend is also rising as an economic and social burden. The smartization phenomenon, however, could neutralize the possible negative impact of the demographic onus in terms of both supply and demand sides by escalating work efficiency and customer convenience. It will transform the existing industries to be 'smarter' while promoting the customers' consumption pattern through technological innovation. Hence, digital transformation could be the alternative solution to the decreasing trend of the working-age population. In other words, digital transformation and changes in the economic mechanism from labor-intensive to smart-intensive could offset the negative effect by filling in for vacancies of the manpower due to the demographic transition.

More specifically, labor-intensive industries are most likely vulnerable to the automation and utilization of industrial robots. In China, the automation systems driven by artificial intelligence (AI) and robots may replace about 14 million jobs only in manufacturing sectors by 2030. Thus, expanding robot installation and

digitization could significantly reshape the supply market. In terms of the increase of wages by 65% from 2008 to 2019, adopting automation by robots as an alternative could not be an optional choice, but a mandatory to maintain the low opportunity cost and pursue further economic development.

Moreover, along with the strategy of AIDP, the Chinese government is actively subsidizing the enterprises and supporting the high-level education of human resources to upgrade existing industries to be 'smarter' with high-technology to become a leading country of smart (AI) industries by 2030. In fact, the service-related industries may be less vulnerable than manufacturing sectors since it requires more than a manual labor activity such as altruism, creativity, and various social senses. Still, it is inevitable to adopt automation by AI technology and robots in various industries, which could affect both consumption patterns and the way of economic development overall in the future. Unlike the past when manpower was a key factor to the economic development, the 4th industrial revolution based on digital transformation is emerging as a new catalyst.

Consequently, the trend of both "Made in China" and "Sell in China" are upgrading by "Smart in China" phenomenon to accomplish further economic development. Thus, digital transformation and smartization of existing industries may be a game changer in the matter of demographic transition in 21st century by substituting the possible vacancies of the working-age population's labor force. Malthus also could have argued differently regarding demographic change if he had foreseen the rise of digital transformation.

5.2 Limitations

The following thesis paper is a ‘qualitative’ research mainly based on the evaluation of demographic transition trend and economic development. Most of the statistics are projections about the population change and market size of industries. Therefore, it has the limit of a ‘quantitative’ research area, which could numerically demonstrate the results with the correlation in between the demographic transition and economic development. Further quantitative research about how digital transformation affect both economic development and the demographic transition may be beneficial.

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국문초록

1980년대 세계 생산요소 가격 상승과 국제분업 구조 하에서 중국 연해지역은 해외 기업들의 외국인직접투자(FDI) 최적지로 급부상하였다. 당시 중국은 저임금의 풍부한 생산가능인구를 기반으로 한 노동집약적 2차 산업 중심의 수출주도형 발전 전략을 추진하였으며, '세계의 공장'으로 불리면서 고도의 경제발전을 이루어 냈다. 이러한 '인구 보너스'에 기초한 중국의 경제성장은 2000년대에도 지속 유지되었으며, 2008년 글로벌 금융위기를 계기로 성장동력의 전환이 이루어졌다. 경제 위기 회복 과정에서 중국은 해외 수출의 감소를 국내시장 공급 확대 및 구매력 확충 등을 통하여 상쇄시키고자 하였으며, 14억 인구를 기반으로 한 내수시장 활성화를 토대로 '세계의 시장'으로도 부상하고 있다.

한편, 중국은 풍부한 잉여노동력을 활용하는 동시에, '1가구-1자녀' 산아제한 정책과 합계출산율 감소를 통해 낮은 유년 부양비를 유지할 수 있었다. 다만, 생산가능인구가 정점에 이른 2009년(72.94%) 이후 2차 산업이 GDP에서 차지하는 비중 또한 점차 감소세를 보이기 시작하였으며, 증가하는 총 부양비와 지속적인 출산율 둔화 및 인구 고령화로 인해 '인구 부채' 기조로 전환되어 가고 있다. 따라서, 향후에는 중국 인구의 가파른 고령화 추세로 인해 총 부양비 증가와 가계 저축의 감소, 그리고 연금과 건강보험 등 각종 부양 부담의 가중이 경제발전에 부정적인 영향을 미칠 것으로 예상된다.

다만, 과거 생산 작업을 인적자원의 노동력에 의존하던 시기와 달리, 디지털 전환을 토대로 하는 4차 산업혁명 기조의 시대적 변화가 새로운 경제발전의 동력으로 떠오르고 있으며, 이는 생산가능인구 감소로 인한 '인구 부채'의 경제적 마이너스 효과를 상쇄시킬 수 있을 것으로 판단된다. 가령, 인공지능(AI) 기술과 로봇을 활용한 자동화 시스템의 출현으로 2030년경에는 중국의 약 1,400만 명의 노동집약형 제조 산업 일자리가 대체될 것으로 예측된다. 또한, 중국은 적극적인 첨단 기술집약형 발전 전략을 통하여 제조업 및 서비스업 등 전 산업 분야에서 빠른 속도로 '스마트화'가 진행되고 있다.

따라서, 본 논문은 첫째, 생산가능인구 증가에 따른 '인구 보너스'가 중국 경제성장에 미치는 영향을 분석해 보고, 둘째, '인구 부채' 시대의 도래와 관련한 시사점과 문제점에 대해 분석해 보고, 더 나아가 기존의 양적인 노동집약적 경제발전 중심에서 '스마트화'의 진전에 따른 새로운 첨단 기술집약형 경제성장 메커니즘이 향후 인구 전환에 미치는 영향에 대해서도 함께 고찰해 보고자 한다.

주요어: 경제발전, 생산가능인구, 인구 전환, 인구 보너스, 인구 부채, 노동집약적, 산업 스마트화
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