Study on the Impact of Aging Population on China's Manufacturing Export Structure

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Abstract

China has entered the aging phase since late 1990s and the process has been accelerating in recent years. Aging population has gradually affected China's demographic dividend and applied potential impact on international trade. This paper reviews literatures in this territory and compares both the aging status and high-tech manufacturing export structure within main economies. An empirical analysis with 26 provincial and 15 year-long panel statistics has been conducted in the paper. The results indicate a positive impact that China's aging population has on the country's manufacturing export structure. Meanwhile, manufacturing development level, FDI, human capital as well as R&D input also have respective relationship with the studying object. Corresponding suggestions based on the analysis have been proposed to optimize the country's export.

Keywords: *Aging population, Manufacturing export structure, Empirical analysis*

1.INTRODUCTION

In 2020, China exported $2,589.9 billion products, with 95.5% are manufacturing products [6]. Apparently, China has developed its export competitiveness in the past four decades, mostly relying on its demographic dividend, which is combined of enormous population and low labor costs. However, the aging problem may affect this labor force advantage.

The aging population has become one of the key issues in modern China's society, with the characteristics of an accelerating process and expanding influences in many aspects, including demographic structure, industrial structure as well as trade structure. The reducing proportion of working-age population would result in an erosion in labor cost advantage and may further lead to a decrease in comparative advantage in international trade.

In order to hedge the drawbacks of population aging, export restructuring in terms of optimizing export products with more added value has been paid more attention. The study is aiming to figure out whether the population aging would have significant influence on the manufacturing export structure.

2.LITERATURE REVIEW

2.1. Research on the Relationship between Aging and Economic Development

Foreign scholars studied more on the relationship between aging and economy since developed countries encountered aging problems earlier than developing countries.

A quantitative study illustrates that even though the reduction in birth rate has a negative effect on output growth, extended life expectancy has a more positive one to exceed, thus promotes long-term economic development [7].

In other research, economic growth would be compromised by population aging. Due to the redundant elder people, Japan faces a lack of input of productive factors and restrictions of gross national product increase [3]. US scholars also find that a 10% increase in the proportion of the population ages 60+ would drop the growth rate of average GDP by 5.5% [5].

G. Vilas Bhau et al. (Eds.): MSEA 2022, ACSR 101, pp. 661–667, 2023.
https://doi.org/10.2991/978-94-6463-042-8_95

2.2. Research on the Relationship between Aging and Export

Referring to the studies on aging and export, it is observable that the quantity of labor forces would affect a country's export structure. A country with higher proportion of aging population would accumulate capital factor, thus it will export capital-intensive products due to more comparative advantage in this segment [2][8].

China's export situation is similar. The population aging trend is inevitably promoted the prices of input factors in labor-intensive industries, but it is in favor of export restructuring [1][10]. Thus, population aging shifts China's trade comparative advantage from labor-intensive to capital-intensive, both in theoretical and empirical analysis [9].

2.3. Research on the Relationship between Aging and Manufacture

According to the research on the relationship between aging and manufacturing export, Korean scholar finds that the changes of demographic structure towards aging have negative influences on Korean manufacturing export as well as its productivity [4].

Studies shows that the population aging in China's does not essentially damage the low-cost competitiveness but forms a mechanism to reinforce and optimize the manufacturing structure [11][12]. Empirical research also indicates the positive affect that aging has on manufacturing upgrading. The demands for high-tech and health-care products promote this upgrading process [13].

3.CHINA'S AGING STATUS AND HIGH-TECH EXPORT

3.1. Population Aging Status and Comparison

The term "aging society" is defined by United Nations in 1956. A country where the amount of 65+ years old people occupy more than 7% in its population is regarded as an aging society.

According to China's National Bureau of Statistics, China entered aging society in 2001 with a 7.1% proportion of old people, and the total amount was 90.62 million, shown in Figure 1. The number broke through 100 million in 2005, and the proportion reached 10% in 2014. The latest figure in 2020 was 190.64 million old people, with a 13.5% proportion in total population.

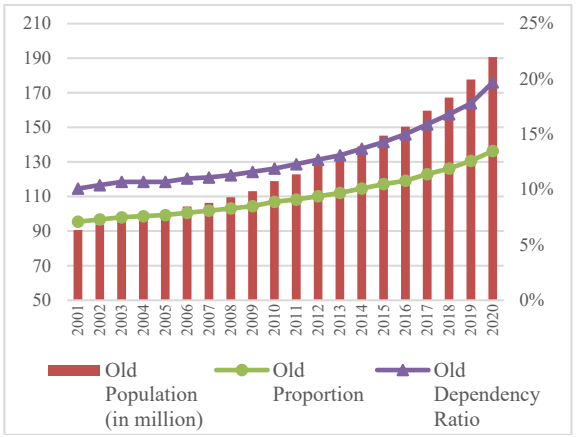

Figure 1: China's aging status in 2001-2020.

Meanwhile, another vital index, the old dependency ratio which is calculated by the ratio of retired population to working-age population, is indicated in Figure 1 either. China has encountered nearly doubled old dependency ratio in twenty years, from 10.1% to 19.7%. In other words, the working people have to foster 8 more old people in the past two decades. China is facing the aging population with huge old people basic and accelerating growth.

Compared to the data in main economies from World Bank, Figure 2 illustrates a clear trend of increasing aging population all around the world. Developed countries such as Japan and European Union reached more than 20% old proportion, while USA also witnessed a rapid growth. South Korea, Singapore and India, which are generally regarded as main manufacturing export economies, have similar accelerating aging problems as China does, especially in recent five years.

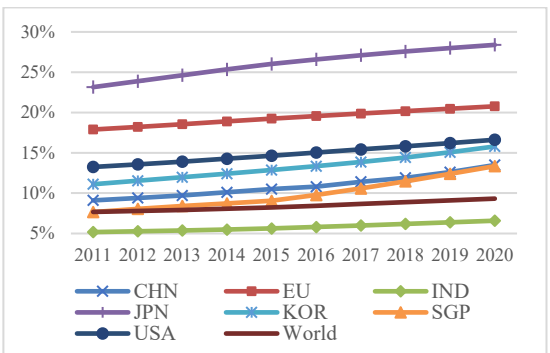

Figure 2: Comparison of aging proportion in different economies.

3.2. High-tech Manufacturing Export Structure and Comparison

Since China's accession to the WTO, the country's manufacturing industry has grown rapidly, which has greatly improved the employment rate and the level of economic development in China. In addition, due to the export comparative advantage of China's manufacturing industry, it also promotes the stable supply of

manufacturing export products to a certain extent to the world, especially during the COVID-19 pandemic period. China's manufacturing subsectors such as pharmaceuticals, automobiles and chemicals saw growth of 40% or more in 2021, according to the National Bureau of Statistics.

Manufacturing exports account for the largest proportion in China's total export. It broke through 90% in 2005 and has remained above that since then. It has also exceeded the world average level since 2000, which has been around 60% ~ 75%.

High-tech manufacturing plays an important role within the manufacturing industry. It not only requires cutting-edge technologies replacing old ones, but also upgrades outdated manufacturing processes to new ones. Thus, a country with a higher high-tech manufacturing export proportion would possibly gain more comparative advantage in manufacturing export.

Figure 3 below shows the comparison between main economies in terms of high-tech manufacturing export structure. Singapore has remained the highest level in this decade, meanwhile, south Korea presented strong potential to catch up in recent five years. China maintained its high-tech manufacturing export proportion around 30% for quite a long period. Developed economies such as USA, Japan and European Union keep their proportion between 15% to 25%, where the world average level is also in that range. In the future, India would invest more in high-tech manufacturing industry to optimize its export structure.

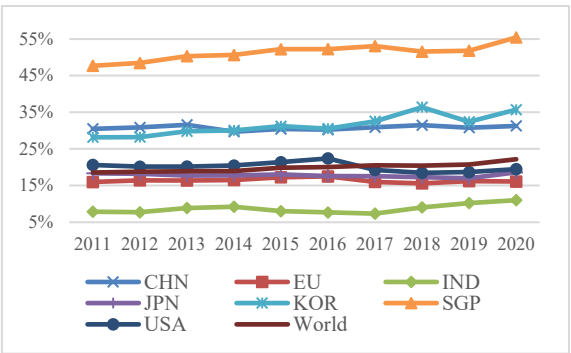

Figure 3: Comparison of high-tech manufacturing export proportion in different economies.

4.IMPACT MECHANISM

According to the theory of factor endowment, the abundance of factor endowment determines the structure of comparative advantage, thus, it further affects the export structure. In addition, the changes of factor endowment in a country will lead to the changes of comparative advantage and it will change the country's export structure.

Moreover, based on the national competitive advantage theory, domestic demand is also a key issue to determine a country's export competency, which would affect the country's export structure either.

This study applies the impact of aging population on China's manufacturing export structure in three approaches, shown in Figure 4.

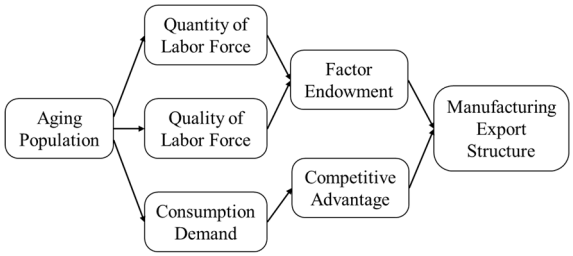

Figure 4: Three impact approaches of aging on export structure.

4.1. The Quantity of Labor Force

The most direct impact of population aging on labor force is to reduce the supply. As the proportion of elder population continues to expand and the old dependency ratio continues to grow, it is foreseeable that the labor market will encounter shortages. The change of the quantity of labor force will definitely affect the labor factor endowment in China, thus, affecting the manufacturing export structure.

In addition, shortages of labor force will cause the increase of labor prices and then damage the manufacturing companies' competitive advantages gained from low labor costs. To deal with the problem, companies would try to upgrade their businesses through more investment in research and development. Thus, the change of the quantity of labor force promotes manufacturing industry to shift from labor-intensive to an export structure with more capital-intensive and technology-intensive products.

4.2. The Quality of Labor Force

Another impact of population aging on labor force is to improve the quality of labors. The extension of life expectancy of elder population represents more working experience and proficiency. Retirement age has been postponed gradually and skillful labors could have longer working life. Their experience and knowledge will improve the quality of labor force.

On the other hand, since life expectancy has extended to 76.34 in 2015 [6], and the elders occupy considerable job opportunities, younger population will receive longer term education or professional training. The proportion of well-educated population will also improve the quality of labor force.

Consequently, the development of quality of labor force will change the structure of factor endowment in China, and then affect the export structure.

4.3. The Consumption Demand

Different age groups have different patterns of consumption demand. Aging population amplifies the elders' demand for several products and services such as healthcare, medicals and biotechnology, which would affect the commodity structure in China.

Meanwhile, China's elder population has more accumulated wealth and disposable income due to the habits of saving. Companies have to attract these sophisticated domestic consumers by providing more elaborate products with high-tech and quality. It develops the competitive advantage of Chinese export products, thus, affects the high-tech manufacturing export structure.

5.EMPIRICAL ANALYSIS

5.1. Model Formulation

The study assumes that aging population will affect China's high-tech manufacturing structure, thus formulates a provincial-sequence panel model below:

$$STR_{it} = C + \alpha_1 ODR_{it} + \alpha_2 CV_{it} + \delta \quad (1)$$

STR_{it} is the abbreviation of *Structure*. It is the explained variable representing the high-tech export proportion in total export in province *i* in year *t*.

ODR_{it} is the abbreviation of *Old Dependency Ratio*. It is the core explanatory variable and calculated by the ratio of aging population to working-age population in province *i* in year *t*.

CV_{it} represents a series of control variables including *MDL* (manufacturing development level), *FDI* (foreign direct investment), *HC* (human capital) and *RD* (research and development input).

α_1 and α_2 are the coefficients to variables, while C is the constant term and δ is the error term.

Thus, the whole model is formulated below:

$$STR_{it} = C + \alpha_1 ODR_{it} + \alpha_2 MDL_{it} + \alpha_3 FDI_{it} + \alpha_4 HC_{it} + \alpha_5 RD_{it} + \delta \quad (2)$$

5.2. Variables Selection and Data Proceeding

The empirical analysis utilizes statistics of twenty-six provincial areas (excludes Xinjiang, Ningxia, Gansu, Qinghai and Xizang) in fifteen years (from 2006 to 2020). Variables are defined in Table 1.

Table 1: Variables and data source.

Variable	Full Title	Data Source
STR	Structure	Customs Database
ODR	Old Dependency Ratio	Statistics Yearbook
MDL	Manufacturing Development Level	High-tech Statistics Yearbook
FDI	Foreign Direct Investment	Statistics Yearbook
HC	Human Capital	High-tech Statistics Yearbook
RD	Research and Development	Statistics Yearbook

(1) High-tech manufacturing export structure is selected as the explained variable. *STR* is the ratio of high-tech manufacturing export volume to total manufacturing export volume. Detailed high-tech industries are selected by the HS two-digit and shown in Table 2. The respective export volumes of these high-tech industries are proceeded from China's Customs Statistics database.

Table 2: List of high-tech industries.

HS Code	Code Description
HS 30	pharmaceutical products
HS 37	photographic or cinematographic goods
HS 84	nuclear reactors, machinery appliances, etc.
HS 85	electrical machinery and equipment, etc.
HS 86	railway or tramway locomotive, etc.
HS 87	vehicles and parts and accessories
HS 88	aircraft, spacecraft and parts
HS 89	ships, boats and floating structures
HS 90	optical, medical or surgical instruments, etc.

(2) Old dependency ratio is selected as the core explanatory variable. *ODR* is calculated as the elder population divides the working-age population in different provincial areas.

(3) Manufacturing development level is the first control variable, which is proceeded as the ratio of added value in high-tech manufacturing industries to the one in whole manufacturing industries. Higher *MDL* represents a more advanced industry structure.

(4) Foreign direct investment is the second control variable, which is proceeded as the ratio of *FDI* volume in manufacturing industries to the total *FDI* volume. Foreign companies generally expand their businesses in China alongside with more advanced technologies and managerial experience, thus, potentially optimize the export structure.

(5) Human capital is the third control variable, which is proceeded as the ratio of the number of employees in high-tech industries to the total labor force. Increasing *HC* represents premium factor endowment and potential export structure upgrade.

(6) Research and development input is the fourth control variable, which is proceeded as the ratio of *R&D* input to the GDP in different provincial areas. With more *R&D* input, it is beneficial for product quality and export comparative advantage.

5.3. Descriptive Statistics

According to the descriptive statistics in Table 3, the mean value of high-tech manufacturing export structure is 21.35 and old dependency ratio is 14.51. Samples have considerable differentiation based on the standard deviation. *R&D* input has the largest diversity within control variables.

Table 3: Descriptive statistics.

Variable	Obs	Mean	Min	Max	S.D.
STR	390	21.35	3.378	46.33	12.37
ODR	390	14.51	9.780	22.61	3.227
MDL	390	4.461	2.198	5.689	0.873
FDI	390	1.365	0.225	3.283	0.699
HC	390	1.083	0.270	2.812	0.671
RD	390	2.396	0.165	10.09	2.051

5.4. Regression Results

For panel statistics, the regression form should be determined before regression analysis. Fixed Effect model is selected and implied after F-test and Hausman-test. The regression results are presented in Table 4 below.

Table 4: Regression results.

Variable	Coefficient and Significance
C	-49.557*** (-11.49)
ODR	1.737*** (7.50)
MDL	6.807*** (9.89)
FDI	2.720*** (3.42)
HC	7.728*** (5.58)
RD	1.209*** (2.73)
R-squared	0.649

Note 1: *** represents 1% confidence level.
Note 2: number enclosed in brackets represents t-value of the coefficient estimates.

Thus, the regression model with coefficients could be listed as:

$$STR_{it} = -49.557 + 1.737 * ODR_{it} + 6.807 * MDL_{it} + 2.72 * FDI_{it} + 7.728 * HC_{it} + 1.209 * RD_{it} + \delta \quad (3)$$

Since all the variables have passed the confidence level test shown in Figure 4 above, it implicates that there are strong connections between explained and explanatory variables. For every 1% increase in population aging, the manufacturing export structure would be optimized to higher high-tech proportion by 1.737%. Thus, aging population in China could upgrade the manufacturing export structure, based on this paper's empirical analysis.

In addition, manufacturing development level, foreign direct investment, human capital as well as R&D input could promote China's manufacturing export structure with added-value and strengthened competitiveness.

6.POLICY SUGGESTION

6.1. Protecting Aging Population against COVID-19

The analysis above indicated that aging population has positive impact on China's manufacturing export structure. The aging population should be treated as an equity rather than a liability. The elders' skills and experience would be well utilized for social development.

It is suggested maintaining the demographic structure and protecting the elders against diseases and death, especially the coronavirus.

The government would encourage the elders to vaccinate and acquire immunity as soon as possible. Wearing masks and avoiding crowds are advised in order to reduce the possibility of infection, either.

6.2. Optimizing Manufacturing Export Structure

China's population structure has gradually changed into a status of low birth rate, low death rate and low natural growth rate. There is a necessity to hedge the drawbacks of aging society by optimizing the manufacturing export structure. The authorities of different provinces would propose a series of policies to restructure manufacturing export.

(1) Keep the old dependency ratio at a healthy and sustainable level. The fertility rate is encouraged to be

improved and the elders are encouraged to extend their working lives for higher pensions in the future.

(2) Promote manufacturing companies to expand the added value in their businesses by substitute outdated capacity with high technologies. Subsidies and tax reduction would be issued to the qualified companies.

(3) Invite foreign direct investment to absorb advanced technologies and managerial experience. Just like the case that the Shanghai authority attracted Tesla for domestic manufacturing, local government would propose various investment invitation policies.

(4) Improve the quality of labor force and R&D input. Companies and universities would cooperate to ensure school leavers have right skills when they graduate. Professional training is also suggested to the employees who wish to improve their abilities. Meanwhile, government may encourage companies' internal or external R&D activities by arranging tax credit for those expenditure.

7.CONCLUSIONS

China is encountering an accelerating aging process and the aging population achieved at nearly 200 million in 2020. The old dependency ratio has almost doubled in two decades and is catching up the developed economies. On the other hand, China's high-tech manufacturing export proportion has remained at around 30% and is far behind to those well-performed economies.

The aging population would affect China's manufacturing export structure in three approaches: reducing the quantity of labor force, enhancing the quality of labor force, and upgrade domestic demand.

An empirical analysis has been conducted in this paper to study the quantitative impact. A multiple regression model with panel statistics of fifteen years and twenty-six provincial areas in China has been proceeded. It indicated that aging population has positive impact on China's manufacturing export structure -- for every 1% increase in population aging, the manufacturing export structure would be optimized by 1.737%.

Corresponding suggestions to optimize the manufacturing export structure are proposed then, including protecting the aging population, utilizing elders' experience, upgrading the manufacturing capacities, inviting foreign investment as well as improving human capital and R&D input.

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