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Research on the Influencing Factors of the Complexity of Medical Device Export Technology

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Abstract

In this paper, the data from "international trade center" is used to calculate the technical complexity index of the representative sample countries of medical device trade, and the transnational panel data model is used to compare the influencing factors of the technical complexity of the developed and developing countries of the sample countries. The results showed that: 1) health expenditure, human capital, R & D investment and foreign investment all have a positive impact on the export technology content of medical devices, of which health expenditure and human capital had a greater impact; 2) the aging of natural resources and population have a negative impact on both developed and developing countries; 3) import trade has a stable positive impact on developed countries, but has no significant impact on developing countries; 4) population size has a stable positive impact on medical device products in developed countries, but has a negative impact on developing countries. Finally, this paper gives some suggestions to improve the export technology level of medical device products in developing countries based on multi-dimensional empirical analysis.

Keywords

Medical Devices, Export Complexity, Panel Model, Influence Factors

1. Introduction

With the continuous improvement of People's health consciousness and the gradual deepening of globalization, the international status of medical devices has been rapidly raised, and medical devices have also received more attention, most of the former researchers focus on the research and development of medical devices and the analysis of the trade of medical devices, but the factors affecting the export technology of medical devices have not been studied，which is what this article exploring.

People's health is an important symbol of national prosperity and national prosperity. Health is the most important thing related to the vital interests of the people. To pay attention to health, we must pay attention to the development of the pharmaceutical industry. As a branch of medical industry, medical equipment is the most important basic equipment in the construction of medical service system and public health system. Medical equipment has a high degree of strategic, driving and growth. Its strategic position has been widely valued by all countries in the world, and has become an important symbol of national scientific and technological progress and national economic modernization level.

Under the tide of international division of labor, from the perspective of medical industry and its important market driving forces, this paper describes the current situation of China's domestic medical device market and defines the potential opportunities for foreign capital to enter China's medical device market. Meanwhile, this paper scientifically and objectively evaluates the technical complexity of medical device exports, compares developed countries with developing countries and finds out the gap between them, and analyzes the influencing factors of the technical complexity of medical device, which is not only conducive to the reasonable evaluation of the current situation of the development of medical device industry, but also conducive to promoting the technological innovation and development of medical device in developing countries.

2. Literature Review

The development of medical devices in foreign developed economies is earlier than that in China. At present, foreign research on China's medical devices is mainly to explore the current situation of trade and analyze the prospect of China's medical device market, or foreign researchers based on their own country, put forward the shortcomings of the current system of medical devices.

Boyer et al. (2015) thinks that with the increase of the aging population and the improvement of international economic status, it is particularly important to evaluate its contribution to the domestic and international market of medical devices. The paper describes the current situation of the domestic medical device market in China and defines the potential opportunities of foreign investment in it. It is believed that the recent medical reform in China to meet the growing demand caused by aging and migrant population has had a positive impact on market growth. Zhang et al. (2016) focused on the rarely reported investment in medical equipment. From the perspective of medical industry and its important market driving force, the paper analyzes the current situation of China's medical device market, and reveals that the market of medical devices in China has significant growth potential.

Lee et al. (2018) used analytic hierarchy process to investigate 35 experts to determine the priority of improving the distribution structure of medical devices. AHP analysis showed that supply stability was the most important factor, followed by transparency, efficiency, intelligent supply and cost reduction. A stable supply system must be established to manage crises through supply stability and to provide opportunities for fair trade through increased transparency. Sorenson & Drummond (2014) studied the regulatory system of medical devices in Europe and America and put forward improvement suggestions. Dietrich & Sharfstein (2014) believes that FDA must ensure that an appropriate level of supervision is sufficient to ensure the safety and effectiveness of the equipment, but it cannot be too heavy to hinder the progress of new technologies.

Throughout the domestic and foreign literature on medical devices, we find that medical devices are not only the basic equipment of health system, but also a new economic growth point of a country. After years of development, China's medical equipment industry has occupied a place in the world, but there are still many problems. Medical device enterprises are small in scale, and still need a lot of time and energy to achieve economies of scale; China's medical device exports are concentrated in the low-end products, and the high-end products rely on imports; The industrial structure of medical devices is unevenly distributed, and high-end medical devices are in a weak position in the international competition. Although there is still a big gap between China's medical device industry and developed countries, it also shows that China's medical device trade still has a lot of room for development. At present, China's goal is to increase investment in innovation and R & D, improve the complexity of export technology, improve the export structure, speed up industrial transformation and upgrading, and break the pattern of high-end devices relying on imports. And learn from experience, policy efforts to further amend the relevant management mechanism, improve the relevant laws and regulations, to create a good social atmosphere for the development of medical device industry.

The first measurement method is based on the theory of comparative advantage, which is derived from the concept of "trade specialization" proposed by Michaely (1984) based on the theory of comparative advantage. Michaely finally proposed that the per capita GDP of a country affects the value of its export technology. Lall et al. (2006) introduced the concept of "export value-added index" of products, in which the detailed accounting index of added value is expressed by the weighted average of per capita GDP of countries exporting this kind of products, but it is easy to ignore the contribution of small countries. In this regard, Hausmann et al. (2007) further improved, constructed the measurement method of export technology complexity with the apparent comparative advantage of each country's export products as the weight, and used two-step method to measure the complexity level of product level and national level. Kim (2018) used very detailed US import data to evaluate the relative complexity of Korean manufacturing exports in and out of products from 1989 to 2012. It is found that the biggest competitor of South Korea is still Japan's market in the United States, while China is steadily climbing the quality ladder and chasing South Korea.

The second is the measurement method based on the degree of similarity proposed by Schott (2006). The premise of using this method is to select a reference country, generally speaking, a country with a relatively high level of technology. Schott concluded that the more similar the export structure between a country and a reference country, the higher the technical value of a product exported by the country. Although similarity method is conducive to cross-border comparison, the objectivity of choosing reference country is not strong. Wang & Wei (2010) thought in reverse and constructed the export difference index (EDI) from a reverse perspective to measure the difference degree of export structure of different countries. The measurement result is opposite to the result of similarity index, and its export difference is used to reflect the value of export technology.

Hausmann & Rodrik (2003) proposed the concept of product complexity for the first time, and scholars all over the world began to further revise and improve the method of measuring product value based on previous theories.

Since the concept of technical complexity was introduced, in order to improve the technical complexity, numerous scholars have made in-depth research and Analysis on its influencing factors. Most scholars at home and abroad have confirmed that whether it is tangible, intangible, natural or unnatural factor endowment is capital investment (fixed assets, human capital) R & D technology investment will have an important impact on the export technology complexity of products or industries. There are many literatures, so we don't list them one by one. This paper mainly reviews several representative literatures on influencing factors. Foreign research on Influencing Factors of export technology complexity.

This paper reviews the foreign literature on the factors affecting the complexity of export technology mainly from economic growth, international trade, financial development, foreign investment and cultural diversity.

1) Economic growth. Since the measurement of export technology complexity is based on per capita GDP, the economic development of a country will inevitably affect its technology level. Hausmann & Rodrik (2003) and Lall et al. (2006) believe that a country's economic growth can improve its product technology content, and the improvement path is that when a country's comprehensive economic strength level improves, the country will tend to export high-tech content or high value-added products, so as to enhance the country's overall export technology complexity. Then Jarreau (2012) considered the impact of export technology complexity on economic performance by examining the domestic regional differences between 1997 and 2009. The analysis found that the economic growth of the region that specializes in producing products with higher technological complexity will be faster. The research shows that economic growth affects the technological complexity, which in turn promotes economic growth. In previous studies on export technology complexity, Lin et al. (2017) showed that sub Saharan African countries are at the lowest level of world export technology. Recent literature also shows that export technology complexity also

plays an important role in economic development, and then raises an important question, that is, whether the increase of export technology complexity will help to increase the income of sub Saharan Africa. Finally, we use panel data to test the causal relationship between export technology complexity and income in sub Saharan Africa, In the long run, the 1% increase of export complexity index is related to the growth of per capita GDP of about 0.08%.

2) International trade. Processing trade is to reprocess and export the imported intermediate products with high technology content, and also increase the technical complexity of our products. Rodrik (2006) research found that the export and processing trade of foreign-funded enterprises' products are the main reasons for China's advanced export technology. Amiti & Freund (2016) all believe that with the deepening of international division of labor, the technical complexity of China's export products is mainly due to the import of foreign intermediate products. The import of products from developed economies will obtain high-end intermediate products needed for processing trade from outside, which will help to enhance the complexity of domestic final export products. Aristei et al. (2013) believes that imports from developed economies can help a country gain more information and technology from developed economies to enhance the technical level of its products. Sheng & Mao (2017) conducted an empirical study on the relationship between the liberalization of import and export trade and the maturity of export technology of Chinese manufacturing enterprises. The empirical results show that the liberalization trade promotes the technological complexity of Chinese manufacturing enterprises through resource redistribution, and also finds that the impact of reducing import tariff on the complexity of export technology is greater than that of export tariff reduction. Baliamoune-Lutz (2019) in turn investigates whether export trade to developed economies stimulates the export complexity of developing countries. The results of fixed effect estimation show that export trade to developed economies increases the technical complexity of export to the exporting countries, but the return on this effect is decreasing. At the same time, it also found that FDI and income have a nonlinear impact on export complexity, while income impact shows a decline in income, which indicates that the export income of low-income countries to developed economies is higher and the income decreases gradually with the increase of income.

3) Financial development. Manova (2008) added financial factors to the analysis and concluded that the long-term development of enterprises is restricted by financing constraints, the access to the international market is hindered by financing constraints, and the production scale of enterprises is reduced by financing constraints. However, all the above adverse effects can be offset by financial development, so the use of financial development can improve the technical complexity of products. Li & Lu (2018) empirically analyzed the impact of R & D investment and financing constraints on the technology of Chinese enterprises' export products. The theoretical model predicts that the R & D ex-

penditure of enterprises will increase the level of technological complexity, while financing constraints will have a moderate impact on the technological complexity of enterprises' export. Using the data from a Chinese industrial company database, the empirical results confirm their theoretical prediction that financing constraints and R & D investment have a significant moderating effect on the relationship between export complexity.

4) Foreign investment. Tannista & Arnab (2017) proved that the increase of per capita inventory of FDI has a significant and positive impact on the export quality of developing countries in host countries. This study has important policy implications for developing countries. It shows that the accumulated stock of FDI has enabled many developing countries to improve the complexity of their export technologies in the past decades, as Schott demonstrated in previous years.

5) Cultural diversity. Fan et al. (2018) used the cross-border panel data covering 85 countries from 1995 to 2014, and extended the theoretical model of Hausmann et al. (2007) to find that cultural diversity affects the technical complexity of export by increasing the degree of economic heterogeneity. Specifically, cultural diversity promotes the rapid development of economy, makes the technological frontier develop outward, and improves the technical complexity of the export of trade products. At the same time, cultural diversity can also improve the growth rate of export complexity by improving the ability of the economy to operate closer to its technological frontier. According to the pooled random effect regression results, they found that cultural diversity was positively correlated with export complexity, and the impact changed little every year, and the correlation was statistically significant.

3. Current Situation of Export Market of Medical Instrument

From 2001 to 2018, the size of the global medical device market increased from US $98.75 billion in 2001 to US $455.31 billion in 2018. Among them, the trade scale of medical devices in the representative developed countries increased from US $81.63 billion in 2001 to US $340.99 billion in 2018, and that of the representative developing countries increased from US $4.72 billion in 2001 to US $40.35 billion in 2018, Both developed countries and developing countries have greatly expanded in the medical device trade market, but the development of the medical device trade market is not balanced, and the gap between developing countries and developed countries is large.

Developed countries such as Europe, America, Japan and South Korea account for about 85% of the medical device export market, while the proportion of emerging developing countries in the medical device export market is less than 10%, which is a huge gap (**Table 1**). It is proved that developing countries can only share a corner in the big cake of medical device trade, and developed countries are far ahead with a strong advantage. The extreme imbalance also fully proves that developing countries still have a lot of development space in the field of medical device products.

Table 1. Y2001 to Y2018 World representative countries' trade share of medical device in the world.

	European countries		Americas countries		Japan & Korea		BRICs countries		Total	
	EX share	IM share	EX share	IM share	EX share	IM share	EX share	IM share	EX share	IM share
2001	49.6	43.0	32.5	23.8	6.9	9.7	2.7	6.8	91.7	83.3
2002	52.8	44.3	30.1	25.4	5.9	9.2	2.6	5.4	91.4	84.3
2003	55.2	45.4	28.0	25.5	5.4	8.3	2.6	5.5	91.2	84.7
2004	56.4	45.7	26.4	25.0	5.5	7.8	2.9	5.5	91.2	84.0
2005	56.0	45.9	26.8	24.3	5.3	7.6	3.5	5.7	91.6	83.5
2006	55.1	46.2	27.1	23.6	5.1	7.4	3.9	6.2	91.2	83.4
2007	55.3	45.6	26.5	23.0	5.0	6.9	4.3	7.1	91.1	82.6
2008	55.4	46.0	26.1	21.9	4.6	6.7	4.7	7.6	90.8	82.2
2009	55.0	46.4	26.8	21.4	4.4	6.6	4.8	7.6	91.0	82.0
2010	54.6	43.5	26.4	22.1	4.5	7.5	5.1	8.8	90.6	81.9
2011	54.8	42.7	25.5	21.6	4.3	7.3	5.5	9.4	90.1	81.0
2012	52.9	40.7	26.0	21.6	4.5	7.7	6.1	11.1	89.5	81.1
2013	53.3	41.6	25.3	21.6	4.1	6.9	6.4	10.6	89.1	80.7
2014	53.4	42.2	24.9	21.9	4.0	6.6	6.4	10.6	88.7	81.3
2015	50.8	41.0	26.2	23.6	4.2	6.5	6.8	10.0	88.0	81.1
2016	51.0	41.1	26.0	24.0	4.2	6.7	6.7	10.0	87.9	81.8
2017	51.2	40.3	24.9	24.2	4.3	6.7	6.7	10.4	87.1	81.6
2018	50.6	39.4	24.5	24.3	4.3	6.7	6.9	10.9	86.3	81.3
Avg.	53.5	43.4	26.7	23.3	4.8	7.4	4.9	8.3	89.9	82.3

Note: The data is from the international trade center, which is sorted out by the author, with one decimal place reserved, unit: %; EX: export; IM: import.

From the perspective of trade surplus and deficit, developed countries have a stable surplus in the overall trade of medical devices and high-end medical devices all the year round, and only a few years have a deficit in the field of medium and low-end medical devices, which not only reflects the priority of developed countries in the field of medical device trade, It can also be seen that developed countries are more inclined to develop high-end medical device trade in Table 2; For the developing countries, there is a steady deficit in the overall trade of medical devices and high-end medical devices, but there is a steady surplus in the field of medium and low-end medical devices, which proves that most developing countries are in the low-end position in the international division of labor in the field of medical devices due to their late start, Become the processing trade provider of low technology products in the global market in Table 3.

Table 2. Y2001-Y2018 Data of medical device trade in developed countries.

	Total trade volume of medical devices			Trade volume of high end medical devices			Trade volume of medium and low end medical devices		
	EX	IM	Bal.	EX	IM	Bal.	EX	IM	Bal.
2001	435.0	381.3	53.7	303.1	258.3	44.8	131.9	123.1	8.9
2002	523.2	481.9	41.3	380.9	343.4	37.5	142.3	138.5	3.8
2003	646.7	585.3	61.4	462.3	420.0	42.3	184.4	165.2	19.1
2004	763.3	694.4	69.0	547.5	491.9	55.6	215.8	202.5	13.3
2005	866.3	784.2	82.1	614.3	543.8	70.5	251.9	240.3	11.6
2006	942.5	858.7	83.8	691.7	596.5	95.2	250.8	262.2	−11.4
2007	1063.9	956.2	107.7	780.1	670.1	110.0	283.8	286.1	−2.3
2008	1236.0	1093.6	142.4	901.6	762.7	138.8	334.4	330.9	3.5
2009	1210.2	1071.9	138.3	881.8	744.9	136.8	328.4	327.0	1.5
2010	1337.3	1143.3	194.0	960.3	801.3	159.0	377.0	342.0	35.0
2011	1452.4	1257.8	194.7	1046.1	883.8	162.3	406.3	374.0	32.3
2012	1471.6	1270.5	201.1	1062.0	887.6	174.4	409.6	382.9	26.7
2013	1545.1	1340.6	204.5	1104.2	931.1	173.1	440.9	409.5	31.4
2014	1615.4	1399.0	216.4	1148.8	970.0	178.9	466.6	429.1	37.5
2015	1540.1	1357.4	182.7	1094.6	930.7	164.0	445.5	426.7	18.7
2016	1586.3	1420.7	165.6	1122.2	963.8	158.5	464.1	457.0	7.1
2017	1669.5	1488.6	180.9	1182.0	1007.3	174.7	487.5	481.3	6.2
2018	1800.2	1609.7	190.5	1274.0	1091.0	183.1	526.2	518.8	7.4

Note: the data is from the international trade center, with one decimal place reserved after the author's collation, unit: US $100 million. Bal.: balance; EX: export; IM: import.

Table 3. Y2001-Y2018 Data of medical device trade in developed countries in developing countries.

	Total trade volume of medical devices			Trade volume of high end medical devices			Trade volume of medium and low end medical devices		
	EX	IM	Bal.	EX	IM	Bal.	EX	IM	Bal.
2001	12.6	34.6	−22.0	4.4	28.8	−2.4	8.2	5.9	0.2
2002	15.0	33.1	−18.1	5.4	27.0	−2.2	9.6	6.1	0.3
2003	18.9	40.9	−22.0	7.0	32.3	−2.5	11.9	8.6	0.3
2004	24.7	48.1	−23.4	9.2	38.5	−2.9	15.5	9.6	0.6
2005	33.3	57.9	−24.6	12.3	46.9	−3.5	21.0	11.0	1.0
2006	41.6	68.7	−27.1	16.5	55.2	−3.9	25.1	13.5	1.2

Continued

2007	52.3	89.6	−37.2	21.6	72.2	−5.1	30.8	17.4	1.3
2008	66.4	113.6	−47.2	28.4	92.1	−6.4	38.1	21.5	1.7
2009	66.6	109.0	−42.5	29.9	87.1	−5.7	36.7	22.0	1.5
2010	79.3	136.2	−56.9	37.3	108.0	−7.1	42.0	28.2	1.4
2011	95.5	165.9	−70.4	43.7	131.9	−8.8	51.8	34.0	1.8
2012	106.9	200.0	−93.1	49.9	160.2	−11.0	57.0	39.8	1.7
2013	117.7	201.7	−84.0	54.6	158.5	−10.4	63.1	43.2	2.0
2014	125.5	208.2	−82.6	58.1	163.8	−10.6	67.5	44.4	2.3
2015	129.1	191.8	−62.7	59.2	149.9	−9.1	69.9	41.9	2.8
2016	129.2	197.4	−68.2	60.0	153.5	−9.4	69.2	43.9	2.5
2017	138.4	215.9	−77.5	63.4	165.2	−10.2	75.0	50.7	2.4
2018	155.1	248.4	−93.3	71.7	189.0	−11.7	83.4	59.3	2.4

Note: the data is from the international trade center, with one decimal place reserved after the author's collation, unit: US $100 million. Bal.: balance; EX: export; IM: import.

4. Technical Export Complexity Index

Export technology content refers to the added value of export products when a country exports. When medical devices trade between different countries, the medical device products exported by different countries have different values. As a member of the manufacturing industry, the value of medical device industry varies with its position in the international division of labor.

Michaely paid attention to the measurement of export technology content earlier. His view is that a country's per capita GDP directly affects the technical value of a country's exports. According to this theoretical achievement, Hausmann gradually developed it into product complexity and applied it to the study of international trade. He believed that the index of technical complexity is the standard to measure the quality of export products of a country or a region.

Foreign research on the measurement of export technology complexity

At present, there are two typical measurement methods of export sophistication: one is based on comparative advantage theory, the other is based on similarity degree.

The measurement methods based on the theory of comparative advantage are as follows

1) Product level measurement formula

$$PRODY_k = \sum_j \frac{\frac{x_{jk}}{X_j}}{\sum_j \frac{x_{jk}}{X_j}} Y_j \tag{1.1}$$

Among them, the formula represents the technical complexity index of export of *K* products, the per capita GDP of country *j*, the total export of trade of country *j*, and the trade volume of *k*-classified products of country *J*.

2) Country level measurement formula

$$EXPY_j = \sum_k \frac{x_{jk}}{X_j} PRODY_k \tag{1.2}$$

Among them, the formula represents the export technology complexity of country *j*, the export volume of country *j* trade and the export volume of *k*-classified product trade of country *J*. The measurement methods of similarity are as follows:

$$ESI_{ab} = \sum_j \min\left(S_{aj}, S_{bj}\right) \tag{1.3}$$

where is the export share of *J* products of country a, where is the export share of *J* products of country B.

5. Data Description and Model Construction

5.1. Data Selection and Source

This article is based on trade in international trade center. For the representativeness and validity of the sample data, the map database comprehensively compares the export data of the top 50 countries in the export trade volume of medical devices in 2018, and finally selects 42 countries as the research object of this paper, excluding the countries that lack the export data of medical devices and other influencing factors, which is shown in **Table 4**.

According to the different nature of countries, this paper divides 42 sample countries into two categories: developed countries and developing countries. Among them, 26 developed countries include the United States, Sweden, Denmark, Finland, Japan, Netherlands, Belgium, Germany, Australia, South Korea, France, Austria, Switzerland, Ireland, Norway, Canada, Britain, Israel, New Zealand, Italy, Portugal, Slovenia, Singapore, Czech Republic, Hungary and Spain; 16 developing countries include China and Malaysia To West Asia, Brazil, India, the Philippines, Russia, Thailand, Indonesia, Mexico, Poland, Lithuania, South Africa, Turkey, Costa Rica, Romania and Vietnam. The technical complexity of medical device export of the explained variable is measured by the data of medical device trade. The data of foreign investment, R & D expenditure, education expenditure, population, per capita land area and aging in the explained variable are from the world bank database, and the data of health expenditure are from the world Health Organization database. The original data of all monetary units are the current US dollar price, and then the CPI price index based on 2010 is used to reduce. The missing of some data in individual years is supplemented by average or average growth rate.

5.2. Model Construction

According to the previous research, we will make empirical analysis on the relevant

Table 4. HS code classification of medical device products.

Classification of medical devices	6-bit HS code	Product description
Medium and low end medical device products	300510	Adhesive Dressings And Other Artcl Having Adh Lay
	300590	Wadding, Gauze And Similar Articles Etc Nesoi
	300610	Sterile Surgical Catgut, Similar Sterile Mater Etc
	300691	Appliances Identifiable For Ostomy Use
	901831	Syringes, With Or Without Needles
	901832	Tubular Metal Needles & Needles For Sutures & parts
	901839	Med Needles. Nesoi, Catherers Etc And Parts Etc
	901910	Mech-thrpy Appl
	901920	Ozone, oxygen, etc Therapy, Respiration Apparatus, pt
	902140	Hearing Aids
High end medical device products	901811	Electrocardiographs, And Parts And Accessories
	901812	Ultrasonic Scanning Apparatus
	901813	Magnetic Resonance Imaging Apparatus
	901814	Scintigraphic Apparatus
	901819	Electro-diagnostic Apparatus Nesoi, And Parts Etc.
	901820	Ultraviolet Or Infrared Ray Apparatus, & Pts & Acc
	901841	Dental Drill Engines And Parts And Accessories
	901849	Inst & Appln For Dental Science, & Pts & Acc, nesoi
	901850	Other Ophthalmic Instruments & Appliances & Parts
	901890	Instr & Appl F Medical Surgical Dental Vet, Nesoi
	902110	Orthopedic Or Fractre Appliances, Parts & Accessor
	902121	Artificial Teeth And Parts And Accessories
	902129	Dental Fittings And Parts And Accessories
	902131	Artificial Joints And Parts And Accessories
	902139	Artificial Joints & Parts & Accessories Therof, nes
	902150	Pacemakers For Stimulating Heart Muscles
	902190	Oth Artifical Pts Of The Body & Pts & Accessories
	902212	Computed Tomography Apparatus
	902213	Appts Base On X-ray For Dental, Uses, Nesoi
	902214	Appts Base On X-ray, Medical, surgical, vetnry, nesoi
	902221	Appts Base On Alpha, beta, etc Radiation, medical, etc

Notes: The data collected and published by the author.

influencing factors of technical complexity of medical device export. In order to eliminate the influence of heteroscedasticity as much as possible, after taking logarithm of variables, i subscript for country, t subscript for time, the basic panel model is set as follows (Table 5):

$$\ln ZY_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln HR_{it} + \beta_3 \ln RI_{it} + \beta_4 \ln PLAND_{it} + \beta_5 \ln IM_{it} + \beta_6 \ln HI_{it} + \beta_7 \ln AGE_{it} + \beta_8 \ln POP_{it} + \varepsilon_{it} \tag{1}$$

5.3. Variable Description

The index data of export complexity of medical device products are all from the results of trade data calculation. In order to be consistent with the independent variable data year, the calculation results from 2001 to 2018 are selected as the explained variables. FDI means foreign direct investment. We use the proportion of net FDI inflow to GDP of a country to measure foreign direct investment. The expected sign is positive. Im stands for import trade. In this paper, the proportion of medical device imports to GDP is used as an indicator to measure import trade. The expected sign is positive. HR represents human capital. In this paper, the proportion of total education public expenditure to GDP is selected to measure the index of human capital. The expected sign is positive. RI represents R & D investment. In this paper, the proportion of R & D expenditure to GDP is used to represent the R & D investment level of a country, and the expected sign is positive. Land represents natural resources. In this paper, the per capita land area index is used to reflect the situation of natural resources, and the expected sign is negative. Pop reflects the size of the country. In this paper, population is used to reflect the size of the population. The expected sign is positive. Hi

Table 5. Description of variables.

Variables	Meanings
β_0	constant term
β_1 - β_8	regression coefficient
ε_{it}	error term
$\ln ZY_{it}$	logarithmic form of technical complexity of medical device export in China
$\ln FDI_{it}$	logarithmic form of foreign investment
$\ln HR_{it}$	logarithmic form of education expenditure
$\ln RI_{it}$	logarithmic form of expenditure
$\ln PLAND_{it}$	logarithmic form of natural resources
$\ln IM_{it}$	logarithmic form of import trade
$\ln HI_{it}$	logarithmic form of health expenditure
$\ln AGE_{it}$	logarithmic form of aging change and population scale
$\ln POP_{it}$	logarithmic form of population size

represents health expenditure. This paper selects the proportion of public health expenditure in government expenditure to measure health expenditure, and the expected sign is positive. Age represents the aging situation. In this paper, the proportion of the population aged 65 and above in the total population is used to measure the aging structure. The expected sign is negative.

Based on the ranking of medical device export trade volume, this paper selects the data of technical complexity of medical device export from 13 developed countries and 7 developing countries, a total of 20 representative countries for comparative analysis. This paper lists the average annual growth rate of technical complexity of medical device export from 2001 to 2018, the average technical complexity of medical device export from 2001 to 2018 and the ranking, according to **Table 6** and **Table 7**, and the total technical complexity of medical device export in 2001 (**Table 8**), the total technical complexity of medical device export in 2018 (**Table 8**).

Table 6. Export complexity data of high-end medical device products in 20 representative countries.

Country	Y2001	Y2018	Average annual growth rate (%)	Average complexity	Ranking
U.S.A	538.26	711.19	1.65	728.67	5
Netherlands	344.34	1034.48	6.68	699.46	6
Germany	339.33	500.16	2.31	454.55	7
Ireland	697.27	1868.58	5.97	1608.25	2
Belgium	151.58	602.85	8.46	436.88	8
Switzerland	689.02	1132.60	2.97	1225.57	3
France	198.90	358.35	3.52	389.54	9
Britain	185.81	293.88	2.73	289.98	11
Japan	241.17	253.25	0.29	246.77	13
Italy	132.15	200.82	2.49	185.84	14
Israel	509.44	1212.75	5.23	745.06	4
Denmark	245.70	316.41	1.50	286.18	12
Korea	69.38	153.36	4.78	101.38	15
Mexico	158.16	446.47	6.29	340.50	10
Costa Rica	221.17	5739.24	21.11	2265.93	1
China	40.94	91.31	4.83	65.65	17
India	81.79	71.46	−0.79	72.19	16
Brazil	21.21	31.54	2.36	39.14	19
Russia	5.33	7.86	2.32	6.8	20
South Africa	25.57	53.20	4.40	41.03	18

Source: Calculated from sample data.

Table 7. Data on export complexity data of medium and low end medical devices in 20 representative countries.

Country	Y2001	Y2018	Average annual growth rate (%)	Average complexity	Ranking
USA	123.96	220.33	3.44	190.95	7
Netherlands	135.26	355.63	5.85	245.61	5
Germany	45.79	109.11	5.24	86.79	10
Ireland	274.10	844.20	6.84	786.55	2
Belgium	133.15	260.84	4.03	239.57	6
Switzerland	87.62	146.32	3.06	156.74	8
France	45.73	98.85	4.64	78.07	11
Britain	97.26	141.38	2.22	119.03	9
Japan	29.57	68.95	5.11	46.96	14
Italy	27.23	42.57	2.66	38.18	15
Israel	43.13	100.70	5.11	66.67	13
Denmark	327.49	331.57	0.07	445.13	3
Korea	18.01	21.35	1.01	18.60	18
Mexico	164.73	298.76	3.56	255.33	4
Costa Rica	1393.87	3848.99	6.16	2137.47	1
China	66.01	91.07	1.91	76.09	12
India	18.30	42.74	5.12	30.47	17
Brazil	24.69	26.81	0.49	33.52	16
Russia	3.40	2.57	−1.61	2.67	20
South Africa	14.05	15.88	0.72	18.08	19

Source: calculated from sample data by author.

Table 8. Total complexity of medical device product exports in 20 representative countries.

Country	Y2001	Y2018	Average annual growth rate (%)	Average complexity	Ranking
U.S.A	662.22	931.53	2.03	919.62	5
Netherlands	479.60	1390.11	6.46	945.07	4
Germany	385.12	609.28	2.74	541.34	10
Ireland	971.37	2712.78	6.23	2394.80	2
Belgium	284.72	863.69	6.75	676.45	8
Switzerland	776.64	1278.92	2.98	1382.31	3
France	244.63	457.20	3.75	467.62	11

Continued

Britain	283.07	457.20	2.56	409.01	12
Japan	270.74	322.20	1.03	293.73	13
Italy	159.39	243.39	2.52	224.02	14
Israel	552.57	1313.45	5.23	811.72	6
Denmark	573.19	647.97	0.72	731.31	7
Korea	87.39	174.71	4.16	119.98	16
Mexico	322.89	745.23	5.04	595.83	9
Costa Rica	1615.04	9588.23	11.05	4403.40	1
China	106.95	182.38	3.19	141.74	15
India	100.09	114.20	0.78	102.66	17
Brazil	45.90	58.35	1.42	72.66	18
Russia	8.72	10.44	1.06	9.47	20
South Africa	39.62	69.08	3.32	59.11	19

Source: calculated from sample data.

After measuring the complexity of medical devices in 42 countries, it is found that the export technology level of medical devices in the world presents a similar improvement. How to analyze the real development situation of the technical complexity of medical devices in China has become the focus of this section. Therefore, eight developed countries with better medical level are selected to investigate the real situation of China's medical device export technology level by using the index of relative complexity of medical devices in **Table 9**. The relative complexity index of medical device export technology uses the significance of ratio. Take the individual medical device complexity index that you want to study and the individual of comparative study as the quotient. If the ratio expands, it indicates that the gap between the technical level of the studied individual and that of the comparative individual is decreasing, and vice versa.

6. Empirical Analysis

In order to ensure the authenticity and validity of the results, this paper tests the stability of the selected data, and then continues to test the stability of the data after the first-order difference. The test results show that the first-order differences of these variables are all stationary. On this basis, then carry out the co integration test, the test results show that there is a long-term equilibrium between the technical complexity of medical device export and the variables of influencing factors.

We set up a model to do empirical analysis of the factors that affect the technical complexity index of medical device export. We use the method of variable plus logarithm to set the model, and the results will help to offset the influence of heteroscedasticity (**Table 10**).

Table 9. Y2001-Y2018 China's medical device product export technology relative complexity index.

	China/ USA	China/ Britain	China/ Germany	China/ Japan	China/ Italy	China/ France	China/ Switzerland	China/ Denmark
2001	0.1615	0.3778	0.2777	0.3950	0.6710	0.4372	0.1377	0.1866
2002	0.1263	0.2989	0.2188	0.3605	0.5304	0.3025	0.0779	0.1683
2003	0.1162	0.2784	0.2263	0.3623	0.5101	0.2821	0.0656	0.1545
2004	0.1193	0.2410	0.2308	0.3739	0.5094	0.2387	0.0727	0.1532
2005	0.1266	0.2565	0.2356	0.3962	0.5295	0.2375	0.0722	0.1661
2006	0.1250	0.2477	0.2264	0.3990	0.5092	0.2321	0.0685	0.1561
2007	0.1333	0.2515	0.2403	0.4222	0.5781	0.2489	0.0779	0.1503
2008	0.1480	0.3074	0.2664	0.5101	0.6652	0.2706	0.0869	0.1863
2009	0.1427	0.3295	0.2659	0.4932	0.6292	0.2552	0.0889	0.1973
2010	0.1450	0.3428	0.2578	0.5320	0.5874	0.2467	0.0878	0.1677
2011	0.1606	0.4088	0.2657	0.5543	0.6498	0.2919	0.0950	0.1703
2012	0.1699	0.4335	0.2678	0.5664	0.6770	0.3112	0.1399	0.1866
2013	0.1707	0.4589	0.2625	0.5366	0.6717	0.3119	0.1525	0.2178
2014	0.1760	0.4032	0.2690	0.5237	0.6759	0.3303	0.1311	0.2175
2015	0.1767	0.4277	0.2760	0.5267	0.7113	0.3757	0.1386	0.2286
2016	0.1852	0.4237	0.2942	0.5629	0.7389	0.3908	0.1553	0.2508
2017	0.1922	0.4158	0.2983	0.5754	0.7382	0.4040	0.1464	0.2697
2018	0.1958	0.4190	0.2993	0.5661	0.7493	0.3989	0.1426	0.2815

Table 10. Brief description of the variables.

Data sources	Index	Definition	Unit	Expected
ITC and UN bank	ZY	Overall medical device product complexity	/	/
	HY	Complexity of high end medical devices	/	/
	LMY	Complexity of low and medium end medical devices	/	/
UN Bank	FDI	Proportion of net inflow of foreign capital in GDP	%	+
	IM	Proportion of medical device import trade in GDP	%	+
	PLAND	Land area per capita	Square kilometers per person	-

Continued

	RI	Proportion of R & D expenditure in GDP	%	+
	HI	Proportion of public health expenditure in government expenditure	%	+
	POP	population size	Person	+
	HR	Proportion of total public expenditure on education in GDP	%	+
WHO	AGE	Proportion of population over 65 years old in total population	%	-

$$\ln ZY_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln HR_{it} + \beta_3 \ln RI_{it} + \beta_4 \ln PLAND_{it} + \beta_5 \ln IM_{it} + \beta_6 \ln HI_{it} + \beta_7 \ln AGE_{it} + \beta_8 \ln POP_{it} + \varepsilon_{it} \quad (1)$$

$$\ln HY_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln HR_{it} + \beta_3 \ln RI_{it} + \beta_4 \ln PLAND_{it} + \beta_5 \ln IM_{it} + \beta_6 \ln HI_{it} + \beta_7 \ln AGE_{it} + \beta_8 \ln POP_{it} + \varepsilon_{it} \quad (2)$$

$$\ln LMY_{it} = \beta_0 + \beta_1 \ln FDI_{it} + \beta_2 \ln HR_{it} + \beta_3 \ln RI_{it} + \beta_4 \ln PLAND_{it} + \beta_5 \ln IM_{it} + \beta_6 \ln HI_{it} + \beta_7 \ln AGE_{it} + \beta_8 \ln POP_{it} + \varepsilon_{it} \quad (3)$$

The subscript i represents the country, the subscript t represents the time, β_0 the constant term, β_1 - β_8 the regression coefficient and ε_{it} the error term. And $\ln ZY_{it}$, $\ln HY_{it}$, $\ln LMY_{it}$ respectively represent the logarithm of the total export technical complexity of medical devices in China, the logarithm of the export technical complexity of high-end medical devices in China and the logarithm of the export technical complexity of medium and low-end medical devices in China. It represents the logarithm form of the proportion of annual net inflow of foreign capital to GDP, representing the change of 1% in foreign investment and 1% in export technology complexity. It represents the logarithm form of the proportion of total education public expenditure to GDP, representing the change of 1% in human capital and 1% in export technology complexity. It represents the logarithmic form of the proportion of R & D expenditure in GDP, representing the change of R & D input by 1% and the change of export technology complexity by 2%. It represents the logarithm form of annual per capita land area in China, representing one percent change of natural resources and one percent change of export technology complexity. It represents the logarithm form of the proportion of annual import trade volume of medical devices in GDP, representing 1% change of import trade and 1% change of export technology complexity. It represents the logarithm of the proportion of annual public health expenditure in government expenditure, representing the change of 1% in health expenditure and the change of 3% in export technology complexity. It is a logarithmic form of the proportion of the population aged 65 and above in the total population, representing one percent of the aging change and one percent of the export technology complexity change. It represents the logarithm form of the total annual population of a country. It represents one percent change in population size and one percent change in export technology complexity.

According to the more rigorous and complete empirical procedures, the stationarity of the regression data is tested before the empirical test, so as to prevent the occurrence of "pseudo regression" and ensure the effectiveness of the empirical results. In order to ensure the authenticity and validity of the results, this paper will use Levin, Lin & Chu t * (LLC), Im, Pesaran and shin w-stat (IPS) and ADF Fisher chi square (ADF) three methods to test the data stationarity (**Table 11**). If in these three cases, the test statistics reject the original hypothesis that variables have unit roots, then the panel data series is considered to be stationary. In the case of horizontal series, if the three methods can not reject the original hypothesis, it indicates that the unit root data is not stable, and the first-order difference is used to test the stationarity of the data after the difference.

The results show that the level series of explanatory variables such as foreign investment, human capital, natural resources, country size and the proportion of the elderly are stable, while the level series of explanatory variables such as R & D investment, import trade and health investment are non-stationary, and the first-order differences of these variables are stable. Then the cointegration test is carried out.

After stationarity test, it is found that the panel data of R & D investment, import trade and health investment of the explained variable and the explanatory variable are in the same level of single integration. It is necessary to further investigate whether there is a long-term equilibrium relationship between the variables, that is, to carry out cointegration test. In order to get the credibility of the conclusion, we will use both Kao test and pedroni test in **Table 12**.

In the eight statistics of the two methods of Kao test and pedroni test, six of them reject the original hypothesis that there is no co integration relationship, that is, six of them think that there is co integration relationship, which is in line with most of the rules of the test results. Therefore, it can be considered that the overall technical complexity of medical device export in the world is related to R & D investment, import trade, export trade, and so on There is a long-term equilibrium and stable relationship between health investment.

In order to ensure the authenticity and preciseness of the empirical analysis results, the sample value, average value, standard deviation, maximum value and minimum value of the regression data of the total technical complexity of medical device export are statistically explained shown in **Table 13** and **Table 14**.

The empirical analysis is divided into developed countries and developing countries. After Hausman test, the random effect model should be selected. In order to eliminate the multicollinearity of the regression equation and ensure the robustness of the regression results, the stepwise regression method is used to regression them. The final results are as follows (**Table 15**).

Table 11. Regression data stationarity test.

Variable	Measurement form (logarithm)	LLC	IPS	ADF	Is it stable
LnZY	Total export complexity	−0.65046	0.78749	78.1377	Nonstationary
LnHY	High end export complexity	−0.48720	−0.77390	97.4125	Nonstationary
LnLMY	Medium and low and end export complexity	−3.33602***	−1.18119	100.702	Nonstationary
LnFDI	Foreign investment	−4.69209***	−1.87711**	121.548***	Stationary
LnHR	Human capital	−4.18126***	−2.27135**	112.447**	Stationary
LnRI	R & D investment	−2.08870**	0.01033	75.6200	Nonstationary
LnPLAND	Natural resources	−8.41691***	−4.05036***	170.569***	Stationary
LnIM	Import	−2.56873***	−1.04741	103.251*	Nonstationary
LnPOP	Country size	−10.8615***	−5.86086***	190.155***	Stationary
LnAGE	Proportion of old people	−15.7028***	−5.70713***	213.922***	Stationary
LnHI	Health investment	−1.88415**	0.09656	95.7137	Nonstationary
D (LnZY)	Total export complexity	−5.36595***	−6.53149***	192.551***	Stationary
D (LnHY)	High end export complexity	−8.69153***	−7.84474***	211.941***	Stationary
D (LnLMY)	Medium and low and end export complexity	−6.11020***	−6.30930***	180.925***	Stationary
D (LnRI)	R & D investment	−4.41222***	−3.49638***	130.919***	Stationary
D (LnIM)	Import	−8.52523***	−8.14337***	216.796***	Stationary

Continued

D (LnHI)	Health investment	−9.27770***	−6.19304***	189.835***	Stationary

Note: D is the first order difference; Stationary *** means stationary at 1% significance level, stationary ** means stationary at 5% significance level, and stationary * means stationary at 10% significance level.

Table 12. Overall medical device complexity data cointegration test results.

Test method		Statistic	Is there a co integration relationship
Pedroni Residual Cointegration Test	Panel v-Statistic	1.700309**	Co integration
	Panel rho-Statistic	2.942350	Non Cointegration
	Panel PP-Statistic	−7.683736***	Co integration
	Panel ADF-Statistic	−5.103321***	Co integration
	Group rho-Statistic	4.662493	Non Cointegration
	Group PP-Statistic	−9.731409***	Co integration
	Group ADF-Statistic	−1.830720**	Co integration
Kao Residual Cointegration Test	ADF	−2.135520**	Co integration

Note: *** indicates that there is a cointegration relationship at 1% significance level, ** indicates that there is a cointegration relationship at 5% significance level, and * indicates that there is a cointegration relationship at 10% significance level.

Table 13. Statistics on regression of technical complexity of overall medical device exports.

Variable	Sample value	Average value	Standard deviation	Maximum value	Minimum value
LnZY	679	5.355380	1.220183	9.096570	1.742771
LnFDI	679	0.987737	1.145662	4.461424	−6.386735
LnHR	679	1.559301	0.248601	2.139411	0.886363
LnRI	679	0.173134	0.878580	1.520838	−3.101093
LnPLAND	679	−4.570103	1.409413	−0.927024	−8.976607
LnIM	679	−5.930136	0.667385	−3.832182	−8.507887
LnPOP	679	17.22453	1.565011	21.04997	14.50468
LnAGE	679	2.451047	0.486988	3.297634	1.195652
LnHI	679	2.508701	0.420821	3.676301	0.470004

Table 14. Correlation coefficient between independent variables in full sample data.

	LnFDI	LnPOP	LnAGE	LnHR	LnRI	LnHI	LnPLAND	LnIM
LnFDI	1.000							

Continued

LnPOP	−0.286	1.000						
LnAGE	0.018	−0.417	1.000					
LnHR	0.067	−0.479	0.355	1.000				
LnRI	0.009	−0.281	0.645	0.479	1.000			
LnHI	0.058	−0.416	0.636	0.459	0.457	1.000		
LnPLAND	−0.119	−0.047	0.103	0.345	0.035	0.251	1.000	
LnIM	0.437	−0.674	0.447	0.403	0.407	0.497	−0.173	1.000

Table 15. Regression results of influencing factors of complexity of medical devices in developed and developing countries.

variables	lnZY (Developed)	lnZY (Developing)
lnHI	1.49*** (46.01)	0.88*** (21.18)
lnRI	0.79*** (49.22)	0.33*** (12.69)
lnIM	0.57*** (34.21)	
lnHR	0.83*** (22.59)	1.42*** (18.16)
LnFDI	0.11*** (19.31)	0.19*** (9.87)
lnPLAND	−0.14** (−26.94)	−0.69** (−37.75)
lnAGE	−0.58*** (−19.22)	−0.68*** (−16.50)
lnPOP	0.09** (12.50)	−0.25** (−18.96)
-cons	2.48*** (14.56)	3.51*** (8.97)
N	409	270
R^2	0.554	0.509
Time	2001-2017	2001-2017

Note: T statistics are in brackets, *, **, *** are significant at 10%, 5%, and 1% confidence levels respectively.

6.1. Analysis of Measurement Results in Developed Countries

The results of regression analysis in developed countries can be concluded as follows: 1) according to the results of statistical test, the regression equation is significant at the level of 1%, which is statistically significant. 2) Human capital, health expenditure, import trade, R & D investment, foreign investment and population scale have significant and stable positive effects on the technical complexity of medical device export in developed countries, and the proportion of aging and natural resources have significant negative effects on the technical complexity of medical device export in developed countries. 3) Among the significant factors, health expenditure has the best effect on the improvement of the overall technical complexity of medical device export in developed countries. For every 1% increase in health expenditure, the overall technical complexity of medical device export increases by 1.49%; for every 1% increase in human capital, the overall technical complexity of medical device export increases by 0.83%; the other significant factors have similar effects.

6.2. Analysis of Measurement Results in Developing Countries

The results of regression analysis in developing countries can be concluded as follows: 1) from the test results of statistics, the regression equation is significant at the level of 1%, with high significance. The regression equation has statistical significance. 2) Human capital, health expenditure, R & D investment and foreign investment have a significant and stable positive impact on the overall technical complexity of medical device export in developing countries. Population size, aging proportion and natural resources have a significant negative impact on the overall technical complexity of medical device export in developing countries. 3) Among the factors that have significant influence, human capital has the best effect on improving the overall technical complexity of medical device export in developing countries. For every 1% increase in human capital, the overall technical complexity of medical device export increases by 1.42%; for every 1% increase in health expenditure, the overall technical complexity of medical device export increases by 0.88%; the other significant factors have similar effects. 4) Contrary to the expectation, import trade has no significant impact on the technical complexity of the overall medical device export of developing countries, while population size has a significant negative impact on the technical complexity of the overall medical device export of developing countries.

6.3. Comparative Analysis of Measurement Results between Developed and Developing Countries

In the empirical regression of countries with different levels of development, it can be seen that no matter for developed countries or developing countries, health expenditure, human capital, R & D investment and foreign investment all have a positive impact on the export technology content of medical devices, of which health expenditure and human capital have a greater impact on the basis of Table 16. The import trade has a positive impact on the technical stability of medical device products in developed countries, but has no significant impact on the technical content of medical device products in developing countries. The possible reason is that for developing countries, due to historical reasons and weak domestic technical support, it is not able to quickly transform the core

Table 16. Regression results of overall medical device export complexity.

Variables	lnZY	lnZY	lnZY	lnZY	lnZY	lnZY	lnZY	lnZY
lnHR	2.11*** (84.52)	1.21*** (46.75)	0.81*** (32.50)	0.84*** (34.03)	0.52*** (20.32)	0.51*** (18.84)	0.55*** (20.73)	1.33*** (49.75)
lnHI		1.15*** (73.58)	0.75*** (47.58)	0.96*** (53.09)	0.99*** (56.28)	0.99*** (56.25)	1.05*** (57.81)	1.38*** (79.51)
lnIM			0.63*** (67.20)	0.67*** (70.86)	0.63*** (68.21)	0.63*** (56.87)	0.55*** (49.44)	0.23*** (20.65)
lnAGE				−0.34** (−23.04)	−0.67** (−40.57)	−0.67*** (−39.67)	−0.69*** (−40.54)	−0.63*** (−40.04)
lnRI					0.34*** (39.97)	0.34*** (39.04)	0.36*** (41.38)	0.27*** (34.09)
lnPOP						−0.002 (−0.50)		
LnFDI							0.09*** (16.35)	0.11*** (21.53)
lnPLAND								−0.30*** (−71.54)
-cons	2.08*** (52.59)	0.59*** (14.21)	5.96*** (67.10)	6.46*** (71.23)	7.42*** (81.03)	7.45*** (64.57)	6.69*** (63.03)	1.19*** (9.60)
N	714	714	714	714	714	714	679	679
R^2	0.193	0.316	0.406	0.416	0.446	0.446	0.446	0.530
F-statistic	7153.27 ***	6934.02 ***	6827.04 ***	5343.82 ***	4822.99 ***	4019.10 ***	3820.07 ***	4595.04 ***

Note: *, **, *** are significant at 10%, 5%, and 1% confidence levels respectively.

high-tech of foreign countries into domestic production technology, and once developed countries enter into China Trade boycott will cause more losses to the host country. The population scale has a positive impact on the stability of medical device products in developed countries and a negative impact on products in developing countries. This may be because the economic development level of developing countries is relatively low, the population is large, but the support of education and other aspects is not enough. The domestic residents pay more attention to solving food and clothing rather than improving their skills, which leads to the population scale's impact on medical devices in developing countries The negative effect of the technical content of machinery export.

1) With the development of economy and the passage of time, as a whole, the export technology level of world medical device products is on the rise. 2) The average annual growth rate of export technology level of medical device products in various countries is different. Most developing countries have weak medical technology foundation. After years of development, the technical complexity of medical device export has increased, but there is still a big gap with

developed countries. 3) The technology content of medical device export in developed countries is higher than that in developing countries, but Costa Rica and Mexico are developing countries, but they are among the best in medical device technology.

7. Recommendations

Medical devices have a high degree of strategic, driving and growth, its strategic position by the world's universal attention, has become a national scientific and technological progress and an important symbol of the level of national economic modernization. At present, the technical content of most developing countries' medical device exports is low, high-end medical device products rely on imports, and the exports are mainly low-end products. Based on the cross-border panel data research, the analysis of the influencing factors of the complexity of medical device exports has important reference value for developing countries to choose the path of foreign trade transformation and upgrading. Based on this, in order to improve the export technology content of medical device products in developing countries, the following suggestions are put forward:

Firstly, making rational use of external resources. Through FDI and import trade, we can learn from the successful experience of "technology pioneers" and learn from their failures. Standing on the shoulders of predecessors, we can reduce the detours and shorten the gap with the technology frontier faster. After years of development, developing countries have accumulated a certain amount of capital. Compared with capital, they lack advanced technology and management experience. Therefore, it is not only necessary to imitate the technology of developed countries, but also to digest, absorb and even create new technologies, so as to fundamentally improve the competitiveness of medical devices products of developing countries and change the position of developing countries in the global international division of labor.

Secondary, paying attention to the training of human capital. Talents are the core competitiveness of high technology. Human capital has a decisive impact on the technological innovation ability of a country's medical device products. In recent years, developing countries have improved their awareness of talent cultivation. However, from the perspective of international horizontal comparison, there is still a big gap between the level of investment in education and that of developed countries. High-tech R & D talents are scarce. Therefore, we should continue to increase investment in education, at the same time, improve the education system, optimize the education structure, strengthen the education supervision, pay attention to the training of human capital, and improve the level of human capital.

Thirdly, we will increase R & D and innovation capacity and increase health spending. To improve the R & D innovation ability of enterprises and strengthen the health expenditure, we can start from two aspects: government and enterprises. The government can invest the relevant funds and support policies in

China's medical and health undertakings, which can not only improve China's current medical level, but also increase the influence of China's medical device products in the world. The government should establish and improve the system suitable for the development of medical device industry, encourage and guide enterprises to carry out independent innovation, protect the innovation achievements of enterprises, and reward enterprises, research and development groups or individuals with major technological breakthroughs, and strengthen the protection of health expenditure. The enterprise itself should increase the investment of research and development funds in health care and other aspects, constantly improve the work and research environment of talents to achieve the purpose of retaining talents, further strengthen the exchange and cooperation with multinational companies, learn advanced international technology, and ensure the quality and technical level of domestic products in the same kind of products to avoid excessive homogeneity.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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