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Abstract

The medical device market is one of the most attractive and profitable areas in the global economy. Since China opened its doors to the world it has attracted increasing amounts of foreign investment. The Chinese medical device market is currently one of the most promising and fastest growing markets, which is the second largest market in the world with 200 billion yuan (RMB) total sales in 2013. This paper illustrates the geographical distribution of the Chinese medical device industry, combined with the location quotient (LQ) assessment, to reveal the medical device industry's professional level and degree of concentration in each province, providing guidance for investors who are interested in medical device investment in China. The LQ and market share (MS) matrix reveals that the best investment regions in China are: Bohai Economic Rim, Yangtze River Delta and Pearl River Delta Economic Zones.

Keywords

China, medical device market/industry, investment, location quotient

Introduction

The global medical device market is highly centralized, the market share of the developed countries accounted for more than 80% of the global medical device market share (US: 42.4%, Europe: 33%, Japan: 11%) in 2011.^{1,2} Medical devices are a growth industry in China due to increasing medical expenditure, rising healthcare consumption and health awareness improvements. By studying the distribution of the Chinese medical device market and regional advantages, investment strategies for investors who are doing business in China can be optimised and enhanced.

Data

Data on the medical device industry total output value of each province in China from 2001 to 2011 was collected from the China Statistics Yearbook on High Technology Industry.³ Other data such as gross regional product and gross domestic product of China are collected from the National Bureau of Statistics of the People's Republic of China.⁴ The average of the Chinese medical device industry total output value shows Jiangsu, Zhejiang, Guangdong, Shandong, Shanghai and Beijing are the most productive provinces in China. Each Chinese province was classified into five levels according to its average total output value of the medical device industry, which are ≤ 1000 , 1000-4000, 4000-7000, 7000-10000 and ≥ 10000 (million yuan). This information is plotted on the map of China (Figure 1). In this study, we select 30 provinces, the data does not include: Tibet, Taiwan, Hong Kong and Macau.

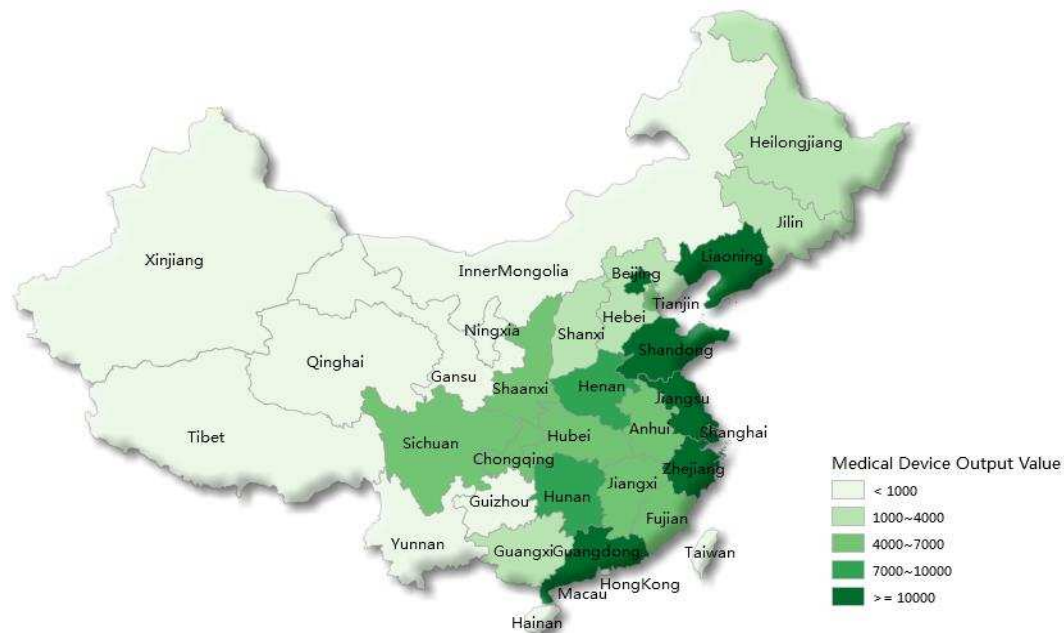


Figure 1: Geographic distribution of the Chinese medical device industry

Methods

A location quotient (LQ) has been used as a proxy for the spatial or geographic dependency of a given economic sector.^{5, 6} LQ is the ratio of an industry's share of the economic activity of the regional economy being considered to that industry's share of the national economy.⁷ The basic formula for the location quotient in regional economic sector can be described as:⁸

$$LQ_{ij} = \frac{E_{ij}/E_i}{\sum_i E_{ij} / \sum_i E_i} \quad (1)$$

Where: E_{ij} =Regional i employment in industry j

E_i =Total regional i employment

$\sum_i E_{ij}$ =National employment in industry j

$\sum_i E_i$ =Total national employment

The LQ analysis technique is frequently calculated on the basis of employment, but employment can be defined in many ways such as service or manufacturing.⁹ Industry LQ is a way of quantifying how “concentrated” an industry is in a region compared to a larger geographic area, such as the state or nation.¹⁰ Therefore, variables in equation 1 could be defined as: E_{ij} = economic activity in area i industry j; E_i = total economic activity in area i; $\sum_i E_{ij}$ = economic activity of industry j in the whole area and $\sum_i E_i$ = total economic activity in the whole area. In this article, the locational analysis technique is applied to the following variables: E_{ij} = provincial output value of medical device industry j in area i; E_i = provincial gross regional product; $\sum_i E_{ij}$ = China output value of medical device industry j and $\sum_i E_i$ = China gross domestic product.

If LQ is greater than one, it is assumed that medical device industry output value exceeds the local demand and appears to be exporting much of its goods to non-local markets or areas, which means the medical device industry in this region has comparative advantages. If LQ is equal to or less than one, it indicates that the medical device industry does not export from the region, and the output value of the medical device industry does not meet the local demand, hence, industry in the region is not strongly competitive.^{7 11}

LQ is an index that measures regional industrial professional level (specialization) and concentration. The higher LQ, the higher the industrial concentration in the region. LQ is a ratio, which reflects the relative degree of professional level skills in one region rather than the actual degree of specialization in this region. For instance, if the medical device industry has high LQ in one region, this result may be because this region has a high output value in the medical device industry or this region has low regional product output value but has high

medical device output value. Therefore, we introduce “market share^a (MS)” into this study to measure the industrial professional level. If $LQ > 1$ and market share is higher than the country average level (in the study, average level= $100\% \div 30=3.33\%$), the industry in the region has comparative advantages. The matrix illustrates the relationship between LQ and MS (Figure 2).

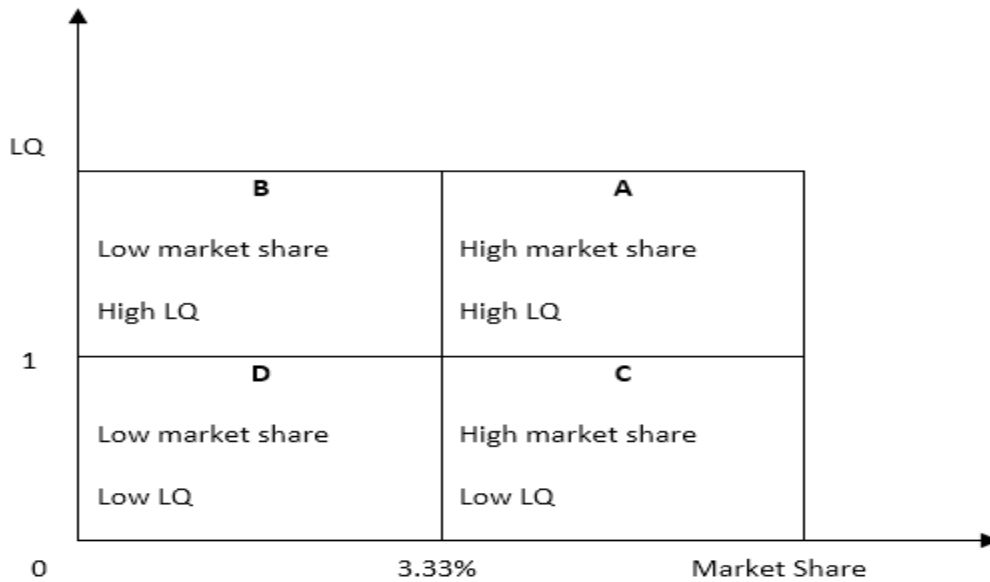


Figure 2: Matrix of each province’s industry professional level

Area A has a high LQ and high market share, provinces in this area have a high professional industrial level and have comparative advantages throughout the country; area B shows that the region’s total industrial scale is too small, industrial output value has a significant share of the regional commercial activity, but actually the industrial level does not have comparative advantages; area C illustrates that the industry has comparative advantages in the country, but other industries in this region also have a high level and comparative advantages, so this industry has a low LQ in the region; area D means that industry does not have any comparative advantages in the region or the whole country.

Results

Based on the data, using the formula for the LQ (equation 1), the LQ results are evaluated for each province. The MS for each province was evaluated from 2001 to 2011. Based on the LQ and MS data we used the criteria defined in Figure 2 to evaluate the industrial professional level of each province, which is shown in Table 1.

^a In this study, market share= $E_{ij} / \sum_i E_{ij}$ (2)

Table 1: Industry professional level of each province in China from 2001 to 2011

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Beijing	A	A	A	A	A	A	A	A	A	A	A
Tianjin	B	B	B	B	D	D	D	D	D	D	D
Hebei	D	D	D	D	D	D	D	D	D	D	D
Shanxi	D	D	D	D	D	D	D	D	D	D	D
Inner Mongolia	D	D	...	D	...	...	...	D	D	D	D
Liaoning	C	C	C	C	D	D	C	C	C	C	D
Jilin	D	D	D	D	D	D	D	D	D	D	D
Heilongjiang	D	D	D	D	D	D	D	D	D	D	D
Shanghai	A	A	A	A	A	A	A	A	A	A	A
Jiangsu	A	A	A	A	A	A	A	A	A	A	A
Zhejiang	A	A	A	A	A	A	A	A	A	A	A
Anhui	D	D	D	D	D	D	D	D	D	D	D
Fujian	D	D	D	D	D	D	D	D	D	D	D
Jiangxi	D	D	D	D	D	D	D	D	D	D	D
Shandong	C	C	C	C	C	C	C	C	C	C	C
Henan	D	D	D	D	D	D	C	C	C	C	C
Hubei	C	D	D	D	D	D	D	D	D	D	D
Hunan	D	D	D	D	D	D	D	D	D	C	A
Guangdong	C	C	C	A	A	A	A	A	C	C	C
Guangxi	D	D	D	D	D	D	D	D	D	D	D
Hainan	D	D	D	D	D	...	...	...	...	...	D
Chongqing	A	A	A	B	B	B	B	B	D	B	D
Sichuan	D	D	D	D	D	D	D	D	D	D	D
Guizhou	D	D	D	D	D	D	D	D	D	D	D
Yunnan	D	D	D	D	D	D	D	D	D	D	D
Shaanxi	B	B	B	B	D	D	D	D	D	D	D
Gansu	D	D	D	D	D	D	D	D	D	D	D
Qinghai	...	...	D	D	D	D	D	D	D	D	D
Ningxia	B	B	B	B	D	D	D	D	D	D	D
Xinjiang	D	D	D	D	D	D	D	D	D	D	D

Area A (high LQ, high MS): from 2001 to 2011, there are four administrative divisions that stay in this area, they are Beijing, Shanghai, Jiangsu and Zhejiang. These four regions have the top medical device industrial professional level and competitive advantages over the rest of the country. Moreover, they accounted for about 55% of the medical device output market share in 2011.

Area B (high LQ, low MS): there are four regions that stayed in area B. From 2005 to 2011, the industrial professional level of Tianjin, Shaanxi and Ningxia moved to area D. Chongqing stayed in area A from 2000 to 2003 but dropped back to area B from 2004 to 2008. These four regions are basically well developed with a good industrial professional level but their market share has not reached the country's average level, they thus do not have a competitive advantage.

Area C (low LQ, high MS): Shandong province has been in this area for 11 years. Liaoning also occupies this area except for 2005, 2006 and 2011. Henan was in area D from 2001 to 2006, from 2007 Henan moved to area C. Provinces in area C have a national competitive advantage in their medical device industry, but low LQ means that the medical device industry does not have competitive advantage in their provinces, however, some strong industries exist in their provinces.

Area D (low LQ, low MS): more than half the provinces (17) stayed in area D from 2001 to 2011. The development of the medical device industry in these provinces was slow.

Area C→A: Guangdong, as China's major economic province, plays a significant role in the Chinese economy. Its medical device industrial professional level moved from area C to area A, which means Guangdong's medical device industry is leading the country, based on the data, the medical device industry is on rising trend, with a growing contribution to Guangdong's industrial output.

Discussion

Using the geographic distribution of the Chinese medical device industry (Figure 1) together with the LQ and MS results indicate that the Chinese medical device industry is mainly concentrated in the Bohai Economic Rim (Beijing; Shandong; Liaoning, etc.) in the north, and the south eastern zone, which are two well-developed economic zones: Yangtze River Delta (Shanghai; Jiangsu and Zhejiang) in the east and Pearl River Delta (Guangdong; Hong Kong and Macau) in the south. These economic zones and cities are located in the industry professional level matrix area A and area C. Medical device industries concentrated in these areas have a competitive advantage, they took about 77% market share in 2011.

Based on the analysis above, three economic zones (Yangtze River Delta; Pearl River Delta and Bohai Economic Rim) have always enjoyed prosperous development of the medical device industry in China. The population of the three economic zones accounts for 25% of the total Chinese population; accounting for approximately 40% of GDP; foreign businesses account for 70% of investments and control 77% of total import and export value.¹² The three economic zones have: (1) A strong industrial base to support medical device development, electronics and mechanical equipment manufacturing contributing to technical cooperation and product support; (2) Developed transportation systems are conducive to trade and technical exchanges domestically and internationally; (3) The most prestigious Chinese universities, colleges and education institutions are located in these areas; (4) Strong medical research and clinical level due to a large number of hospitals; (5) Strong financing channels including domestic and international capital. The rapid economic growth and huge market potential of the Chinese medical device market is recognised by many international companies such as GE, Philips and Siemens, who have been expanding their business in China.

This study has its limitations. The size of the sample is too small to perform statistical analysis. And, the data collected only runs up to 2011. Moreover, the disadvantage of the LQ method is that it may not reflect the actual degree of specialization. For instance, Guangdong has a low LQ but is a promising market, while Ningxia has a high LQ but seems an underdeveloped

region. The LQ method is not the only way to assess the industrial professional level, but is probably the most frequently employed. Some methods like NPV and real options¹³ can also assess the market. But by combining the LQ and MS methods the LQ's error is reduced making the findings of this study more reliable.

Conclusion

According to the above analysis, the Bohai Economic Rim, Yangtze River Delta and Pearl River Delta Economic Zone are considered to be the ideal medical device investment regions in China. The Chinese government has awarded favourable policy preferences to these regions in order to attract more investment, hence, the investment environment is relatively advantageous over other regions in China. Furthermore, the new Chinese medical device regulations that came into force in 2014, made the Chinese medical device market more organised, which is beneficial for investors. Therefore, the three economic zones were chosen as the priority regions for investors who want to invest in the Chinese medical device market.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest

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