

**The Chinese medical device market:
Market drivers and investment prospects**

Abstract

The economy in China has experienced rapid growth and been remarkably successful ever since the reforming and opening-up policy. Like China's economy, the Chinese medical device market is developing rapidly; this paper identifies important parameters controlling this market. Regression analysis shows that the number of hospital visits, aging population and the number of hospitals have a positive relationship with medical device revenues. Therefore, they are the main drivers of the Chinese medical device market. Disease profile is another important market driver. Analysis of the main market drivers, illustrates that the Chinese medical device market offers significant investment opportunities.

Keywords

China, medical device market/industry, market drivers, investment, aging population

Introduction

The global medical device market is highly centralized.¹ 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 2011.² With superior know-how in technology and/or management, international companies are typically larger than domestic companies and have a competitive advantage due to the economies of scale.³ According to Charles Hill and Vernon's product life cycle theory, the developed countries will export their production and technology from their relatively saturated market to the developing countries due to the market pressures and other competition in their established markets.⁴⁻⁶ Despite China only accounting for 3% of the global medical device market share,² this study shows that the developing countries' medical device markets are experiencing rapid growth, especially in China. Increasing medical expenditure, rising healthcare consumption and health awareness improvements are all possible factors in promoting the development of the Chinese medical device market. The Chinese government's healthcare reform has injected additional "power" into the development of the medical device market. In fact, by the end of 2011, the Chinese medical device industry output value was 688.42 billion yuan, total percentage of GDP is 1.40%. Figure 1 shows the Chinese medical device industry output value and its total percentage of GDP, its value continues to climb from 2001 to 2011. In 2011, the percentage of medical device industry output value accounted for 1.40% of Chinese GDP. Although the output value of the medical device industry is currently a limited proportion of the national economy, Figure 1 shows a rising trend year by year except 2008.

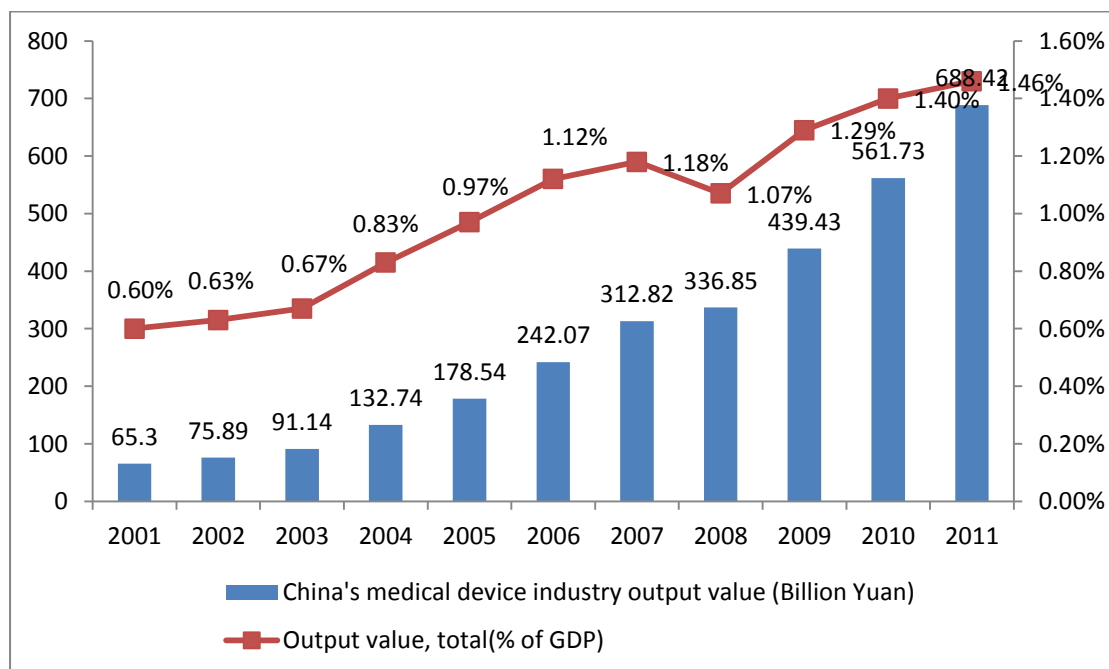


Figure 1 China's medical device industrial output value and its total (% of GDP).

Source: National Bureau of Statistics of China^{7,8}

China's high-end medical device market is dependent upon imports and dominated by foreign companies' products, especially for the diagnosis and treatment devices. Table 1 shows the Chinese medical market trade statistics according to the China Chamber of Commerce for Import & Export of Medicines & Health Products (CCCMHPIE) in 2010. The overall trend of the Chinese healthcare market shows that export value is higher than import value; hence

the export value of the pharmaceutical and medical device industry is higher than the import value. However, only the import value of medical diagnosis and treatment devices is higher than the export value, which took a 29.05% share of total import volume in China. By comparison, medical dressings, disposable products, health protection and recovery products, dental equipment and materials, total only 6.8% of import volume, which is only one-quarter of the import volume of the medical diagnosis and treatment sector.

Table 1 China's import and export structure of medicines and health products, 2010.

(Unit: million USD)

Trade name		Export Value	Export value growth rate annually (%)	Share in total export volume (%)	Import Value	Import value growth rate annually (%)	Share in total import volume (%)
Total		39,733.10	24.87	100	20,464.36	23.98	100
1.Traditional Chinese Medicine		1,944.47	22.78	4.89	687.95	22.61	3.36
2.Pharmaceuticals		23,930.02	28.17	60.23	12,440.84	20.53	60.79
3.Medical Devices		13,858.61	19.83	34.88	7,335.57	30.45	35.85
3.1	Medical dressings	4,687.51	11.95	11.8	207.77	25.63	1.02
3.2	Disposable products	1,922.27	15.42	4.84	880.76	27.73	4.3
3.3	Medical diagnosis and treatment	4,543.60	25.56	11.44	5,944.73	30.34	29.05
3.4	Health protection and recovery products	2,416.41	30.87	6.08	149.37	83.83	0.73
3.5	Dental equipment and materials	288.82	16.51	0.73	152.94	21.37	0.75

Source: CCCMHPIE, 2011⁹

More specifically, Table 2 illustrates the trade statistics for medical devices in China in 2010. The total export value of medical devices reached USD 13.86 billion in 2010, while the total import value reached USD 7.3 billion. North America and Asia are the main export target areas for China, which accounted for 29.23% and 33.7% of the total export volume; the U.S. and Japan are the main export target countries, which absorbed 27.91% and 10.39% of the total export volume respectively. Europe and North America are the main exporters to China, which accounted for 39.01% and 31.41% of the total import volume. Germany and the U.S. are the main importing countries, which provide 17.34% and 30.71% of the total import volume.

Table 2 China's import and export markets of medical devices in 2010. (Unit: million USD)

Country	Export Value	Export value growth rate annually (%)	Share in total export volume (%)	Import Value	Import value growth rate annually (%)	Share in total import volume (%)
Total (All countries)	13,858.61	19.83	100	7,335.57	30.45	100
Asia	4,669.96	12.87	33.7	1,938.77	29.28	26.43
Europe	3,631.06	18.53	26.2	2,861.38	34.38	39.01
North America	4,051.03	24.48	29.23	2,303.79	25.81	31.41
1. U.S.	3,867.61	24.72	27.91	2,252.64	26.48	30.71
2. Germany	778.06	14.72	5.61	1,271.74	35.43	17.34
3. Japan	1,440.07	-13.5	10.39	1,113.90	26.99	15.18

Source: CCCMHPPIE, 2011¹⁰

For the Chinese medical device market, with growth from many sources of demand, medical diagnosis and treatment devices still have a great growth potential. China now has a fee-for-service healthcare system financed largely by payments from patients, employers and health insurance companies.¹¹ However, many patients especially high income people are willing to pay more money by themselves on their treatment, especially for cancers, heart disease, cerebrovascular disease, etc., which needs to use high-tech medical diagnosis and treatment devices or high-grade drugs, which is not affordable for low income people. For example, the average fees for CT whole body scan is nearly 2500 yuan (about USD 400) in China, this is not a small expenditure for low income people; they always choose the most economic ways to treat their diseases. However, China's health institutions especially the Tier-3 hospitals^a have a strong demand for high-end diagnostic devices due to the rising number of visits and inpatients, changed disease profiles, etc..

Data

The improvement of medical and health services has greatly increased the market capacity for the Chinese medical device industry. The important medical device industry drivers are (1) *demographics*, the percentage of the global and Chinese population above 65 years old is growing. (2) *unmet clinical needs*, the trend of using new medical devices or products to address diseases or medical needs that previously were simply not treated is increasing. (3) *procedure penetration*, there is a tendency among doctors to use more medical products and procedures. (4) *pricing*, positive pricing trends have generally been favourable in the medical device industry. Medical products are not selected on the basis of price. (5) *geographic reach*, the market potential for the highly-populous less-developed countries (including China) is very compelling.¹² Studying the market growth drivers of the Chinese medical device market provides information for effective investment in China.

Data for medical device industry revenues from 2000 to 2012 was collected from the China Statistics Yearbook on High Technology Industry.¹³ Other data such as the number of hospital visits and number of hospitals were collected from the China Health Statistical

^a There are three levels of Chinese hospitals: Tier-3 Hospitals (6%) tend to be the best and highest level (first class) hospitals, which may offer the most comprehensive medical treatment; complex clinical diagnosis, advanced scientific research and R&D abilities, which are provincial and municipal hospitals in big cities; Tier-2 Hospitals (34%) are providing comprehensive medical services, basic teaching and research functions, which are municipal hospitals in smaller cities as well as district and county hospitals; Tier-1 Hospitals (25%) are grass-roots healthcare institutions, providing basic medical services, which are the primary healthcare facilities in small towns; Other healthcare institutions account for 35% of total medical institutions.

Yearbook.¹⁴ Data on 65+ population was collected from the China Statistical Yearbook.¹⁵ In this study, datasets contain every mainland Chinese province and city except Hong Kong, Macao and Taiwan. Data on the number of hospitals does not include other health institutions such as Grass-roots Health Care institutions^b, Specialized Public Health Institutions^c and other healthcare institutions. The detailed data are shown in the Supplement Table A.

Methods and empirical analysis

In the real economic environment, one variable is affected by several factors. Multiple regression analysis has been selected as the research method in this study. Assume the regression equation is:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i + \mu_i \quad (1)$$

where Y is the dependent variable, x are the explanatory variables, μ the stochastic disturbance term, and i the i th observation.¹⁶ Using the data in Supplement Table A, we set: Y =medical device revenues, x_1 =number of hospital visits, x_2 =65+ population, x_3 =hospital quantity. From Microsoft Excel we obtained the following regression result:

$$\begin{aligned} \hat{Y}_i &= -1026663.83 + 370.46x_1 + 6119.01x_2 + 3.70x_3 \\ t &= (-7.6946) \quad (6.1616) \quad (1.5722) \quad (0.2008) \quad (2) \\ R^2 &= 0.9928 \quad \bar{R}^2 = 0.9904 \end{aligned}$$

where \hat{Y}_i =estimator of Y_i , \bar{R}^2 =adjusted R , $t = t$ value, used for t test.

Regression shows that the number of hospital visits, 65+ population and hospital number together explain 99% of the variation in medical device revenues. The estimated value of the coefficients of the: number of hospital visits, 65+population and hospital number are 370.46, 6119.01 and 3.70, respectively. The detailed data are shown in the Supplement Table B.

Hypothesis testing (the t test) assumes $H_0: \beta_i=0$, ($i=1, 2, 3$). Regression illustrates that the t of $\hat{\beta}_1=6.1616$, t of $\hat{\beta}_2=1.5722$, t of $\hat{\beta}_3=0.2008$. The t test of significance decision rules is shown in the Supplement Table C. If we assume $\alpha^d=0.05$, degrees of freedom (df) = $n-4=13-4=9$ ^e. According to percentage points of the t distribution (Supplement Table D), $t_{\alpha/2,df}=t_{0.05/2}(9)=2.262$. Therefore, $t_1=6.1616 > t_{0.05/2}(9)$, which is significant, so reject H_0 , which means that the number of hospital visits has significant impact on medical device revenues. $t_2=1.5722 < 2.262$ and $t_3=0.2008 < 2.262$, so accept $H_0: \beta_2=0$ and $H_0: \beta_3=0$, which are insignificant.

The regression model is based on several assumptions, one of the assumptions is that “There is no exact collinearity between the x (explanatory) variables”. Insignificant t values but a high overall R^2 is one of the signals for multicollinearity.¹⁶ After correlation using Excel we obtained $r_{12}=0.9644$, $r_{13}=0.9423$, $r_{23}=0.9831$, which means three explanatory variables are

^b Grass-roots Health Care institution includes community health centre and station, sub-district health centre, village clinic, outpatient department, and, clinic (infirmary)

^c Specialized Public Health Institution includes Chinese Centre for Disease Control and Prevention (CDC), specialized disease prevention and treatment institution, health education centre, maternal and child health centre, emergency centre, centre for blood collection & supply, centre for health supervision and centre for family planning service.

^d α ($0 < \alpha < 1$) is known as the level of significance.

^e n means number of observations

highly correlated. Thus, we regress Y on x individually. Detailed data are shown in the Supplement Table E.

$$\begin{aligned}\hat{Y}_1 &= -609743.60 + 553.34x_1 \\ t &= (-17.23) \quad (26.49) \quad R^2 = 0.98 \quad (3)\end{aligned}$$

The regression (equation 3) shows that the number of hospital visits variable is highly significant, and $t_{\alpha/2,df} = t_{0.05/2}(11) = 2.201$. $t_1 = 26.49 > t_{0.05/2}(11)$, therefore reject H_0 . The same with equation (2)'s results, which means the number of hospital visits has significant impact on medical device revenues.

$$\begin{aligned}\hat{Y}_1 &= -1748028.05 + 19391.36x_2 \\ t &= (-14.20) \quad (16.73) \quad R^2 = 0.96 \quad (4)\end{aligned}$$

The regression (equation 4) and t test ($t_2 = 16.73 > t_{0.05/2}(11) = 2.201$) illustrates that the 65+ population variable was statistically insignificant, whereas now it is highly significant.

$$\begin{aligned}\hat{Y}_1 &= -1897611.31 + 114.02x_3 \\ t &= (-9.98) \quad (11.61) \quad R^2 = 0.92 \quad (5)\end{aligned}$$

$t_3 = 11.61 > t_{0.05/2}(11) = 2.201$, and regression equation (5) shows that hospital number now has a significant impact on medical device revenues, whereas in equation (2) it had no effect on medical device revenues.

According to equation (3), there is a positive linear correlation between the number of hospital visits and medical device industry revenues, which means every one million change in the number of hospital visits will cause a positive change of 553.34 million yuan (RMB) in medical devices revenues.

The huge population and aging population are one of the factors for the growth of China's pharmaceutical market,¹⁷ as well as the medical device market. According to equation (4), the regression shows that every one million change in 65+ population will cause a positive change of 19391.36 million yuan in medical devices revenues. It is clear that the 65+ population is the most important driver of the medical device market. From the year of 1990 to 2010, the Chinese population increased from 1.14 billion to 1.341 billion. However, the population growth rate declined since 1990.¹⁸ Figure 2 shows the trend of Chinese population growth rate from 1980 to 2010, the detailed data are shown in the Supplement Table F. The total population increased slowly, but the population growth rate decreased year by year since 1990 due to the decrease in fertility and mortality.¹⁹ The reduction in population growth rate speeds up the growth in the aging population. An important need of the "aging society" is high quality healthcare, because the elderly are experiencing increasing rates of chronic diseases,²⁰ someone in their 80's is very likely to have four or five chronic diseases. Therefore, the medical device market in China is set to expand.

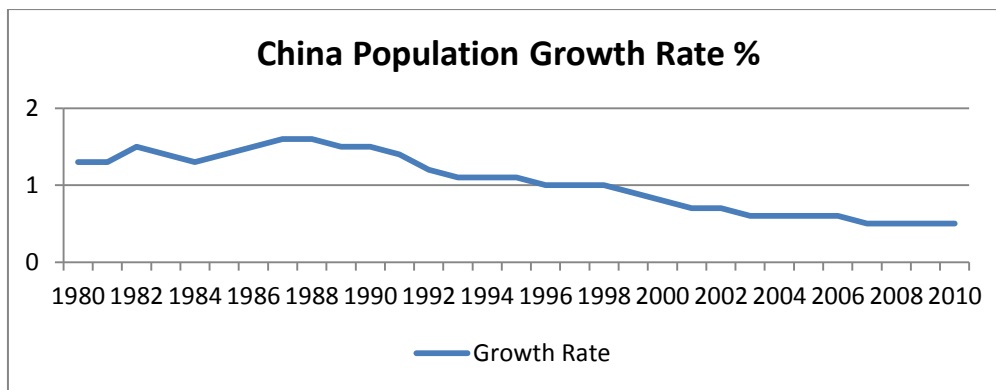


Figure 2 The growth rate of Chinese population from 1980 to 2010

Equation (5) illustrates that the number of hospitals has a positive linear correlation with medical device revenues.

Other driving forces such as diseases cannot easily use quantitative method to assess their impact. China now belongs to the upper middle income countries;²¹ of the top ten leading causes of death in the middle income countries, seven are chronic disease-related deaths, which accounted for 91% of total deaths.²² The higher burden of chronic diseases in low- and middle income countries is manifest in China,²³ which means these diseases will cost a great deal. Although digestive diseases, respiratory diseases, infectious and parasitic diseases are the top ten leading causes of death in low- and middle income countries, we need to focus more attention on cancers, cardiovascular diseases and cerebrovascular diseases, which account for the top three percent of total deaths in China.²² The top three leading causes of death in middle-income countries are cardiovascular diseases, cerebrovascular diseases and respiratory diseases,²³⁻²⁵ there were 2.8 million deaths from cardiovascular diseases in China in 2003.²⁴ Cancer caused the highest mortality and has maintained the first position among the five leading causes of death (cancers, cardiovascular diseases, cerebrovascular diseases, diseases of the respiratory system and injury, poisoning & external causes) in China. The major risk factors causing cancers are tobacco consumption, chronic infections, diet and lack of physical activity, etc.²⁶ Cancer is a leading cause of death globally, accounting for 7.6 million deaths in 2008.²⁷ Nearly 70% of cancer deaths occurred in low- and middle-income countries. It is predicted that deaths from cancer will increase, with an estimated 13.1 million deaths in 2030.²⁸ Cancer is a big problem for society worldwide as well as for China. With the gradual increase in the number of patients and mortality, the demand for diagnosis and treatment devices will inevitably increase. Good market prospects indicate that medical devices for these diseases have great investment potential.

Discussion

This study suggests that the Chinese medical device market is not only driven by the three variables (number of hospital visits, 65+ population and number of hospitals) but is also impacted by the diseases and the government healthcare policy. The purpose of medical devices is to assist with: patient stratification, diagnosis, prognosis, treatment and treatment planning; the macroeconomic variables such as population structure; disease profiles and economic level can affect the demand for medical device services. Disease profiles affect the development of medicine as well as medical device capabilities and the total medical device market. Therefore, diseases should be one of the elements driving medical device investment.

If the incidence or mortality from the disease is low, the demand and frequency of use of the appropriate diagnosis and treatment equipment will be relatively low, the investment payback period for such medical devices will be long for hospitals; in such a scenario, it is difficult for hospitals to recover the cost of medical devices throughout their entire life cycle. So only the large general hospitals will consider purchasing such medical devices. Small and medium-sized hospitals do not have the capacity to buy such equipment. Thus, the market demand for medical devices with low disease incidence is relatively small; investment risk is large and does not have financial investment value. If the incidence or mortality of the disease is high, the demand and frequency of use of the appropriate diagnosis and treatment equipment will be relatively high, the large general hospitals will be very motivated to purchase such medical devices as well as small and medium-sized hospitals because the investment payback period for such devices will be short.

The medical device market has sustainable growth because of the general demographic trends, especially the growth of the aging population and the continued prevalence of diseases.²⁹ For the Chinese medical device market, the growth of hospital visits, aging population, number of hospital and diseases show that the market has great investment opportunities. The main medical devices companies' (such as GE, Philips and Siemens) investment activities and/or mergers and acquisitions in China give good indicators of how the market is developing.

The limitation of this study is that appropriate explanatory variables are hard to find, three explanatory variables made the sample size too small to perform regression analysis. Other market drivers like disease and policy are hard to assess through regression analysis. The multicollinearity often happens in multiple regression analysis, the adjusted results reported herein are more reliable.

Conclusion

According to the regression analysis, the number of hospital visits, 65+ population and number of hospitals are the main drivers of the Chinese medical device market. Diseases are another driving force. Analysis of the prevalence of diseases shows that cancers are the big challenge for the whole medical area, the health care system is experiencing huge pressures from both changing and increasing demands.³⁰ Therefore, significant opportunities exist in the Chinese medical device market due to the growth of the number of hospital visits, 65+ population, number of hospitals and diseases.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest

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