

Analysis of Enhancing the Competitiveness of China Machine Tool Industry from the Perspective of Foreign Trade

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Abstract

With the focus to reveal the fundamental problem that China machine tool industry and the national economic development are incompatible in some aspects, this article not only analyzes the production, import and export of China machine tool industry, but also research the international competitiveness of this industry. According to the development strategies of China machine tool industry and the countermeasures of machine tool enterprises, this article points out the approaches which facilitate the development of China machine tool industry.

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1 Introduction

After People's Republic of China was founded, China machine tool industry emerged. By 1979, China has established a complete machine tool manufacturing system covering bench-type machine tools, heavy-duty & super heavy-duty machine tools, high-precision machine tools, modular machine tools and automatic production lines. After the Reform and Opening-up Policy was implemented in China, China machine tool industry began to cooperate with foreign companies to produce machine tools and introduced advanced technology from abroad.

China's machine tool output value reached USD20.9 billion in 2010, up 36.6%, ranking first in the world instead of third in 2008. Japan ranked second with USD11.84 billion (up 69% year on year), Germany ranked third with USD9.75 billion (down 10% year on year). However, as for the machine tool technology, China is inferior to the most of developed countries, [1].

2 Production and foreign trade of China machine tool industry

China machine tool industry includes 8 sub-sectors, namely metal cutting machine tools, metal forming machine tools, foundry machinery, woodworking machinery, machine tool accessory & attachment makers, measuring tools, abrasive product makers, and other machinery. Metal cutting machine tools and forming machine tools are called "metal processing machine tools" collectively. According to the data released by National Bureau of Statistics of China, in 2010, 4832 enterprises contributed the industrial output value of USD20.9 billion (up 36.6% year on year), and the growth rate was 27 percentage points higher than that in the same period of last year; the machine tool consumption valued USD28.5 billion, up 35% year on year; the machine tool export value reached USD1.85 billion, up 9% year on year; the machine tool import value reached USD9.42 billion, up 60% year on year; therefore, China saw the highest import growth rate of the machine tool industry in the world.

China ranked first in machine tool output value, fifth in export value and first in import value in the world in 2010. In the same year, the global machine tool output value was USD66.3 billion, of which nearly one third came from China; China's machine tool consumption valued USD19.8 billion, accounting for more than one third of the global consumption (USD51.2 billion); therefore, China has become the world's largest machine tool market.

2.1 Output and import & export value of China machine tool industry

As Table 1 shows, the output value of machine tools in China grew rapidly at the average annual growth rate of 37.6% from 2003 to 2008.

Meanwhile, the machine tool export value grew at the rapid annual growth rate of 38.1%, higher than the output value growth rate.

Machine tool import value fluctuated significantly. Its annual growth rate was more than 33% from 2003 to 2004, decreased to 4.1% in 2005, resumed to 32.3% in 2006; the import value declined by 2.4% in 2007 compared with 2006, while it grew by 7.2% in 2008. In 2009, due to the international financial crisis, only the output value grew by 7.6%, both of the export value and import value dropped, by 33% and 22% respectively. In 2010, the export value and the import value grew by 31.2% and 59.3% respectively. According to the above data, export competitiveness of China machine tool has been improved. However, the production, import and export of Computer Numerical Control (CNC) machine tools which reflect the advanced level of China machine tool industry are not satisfying.

Table 1: Output Value of China Machine Tool Industry, 2003-2010
(USD100 mln; %)

Year	2003	2004	2005	2006	2007	2008	2009	2010
Output Value	29.6	40.8	50.0	53.0	71.6	142	153	209
Growth Rate	25.9	37.8	22.5	6.0	35.1	98.3	7.6	36.6
Export Value	3.8	5.2	8.2	11.9	16.5	21.1	14.1	18.5
Growth Rate	22.5	36.8	57.9	44.3	39.3	27.9	-33	31.2
Import Value	37.8	52.6	54.8	72.4	70.7	75.8	59.0	94.2
Growth Rate	33.1	39.1	4.1	32.3	-2.4	7.2	-22	59.3

Source: The information Website of Development Research Center of The State Council (DRCnet), China Machinery Online

Table 2: Total Consumption Value and the Proportion of Import in Total Consumption Value in China Machine Tool Industry, 2004-2010 (USD100 mln)

Year	2004	2005	2006	2007	2008	2009	2010
Total Consumption Value	88.2	96.6	113.5	125.8	152.2	197.9	284.8
Proportion of Import in Total Consumption Value (%)	59.6	56.7	63.8	56.2	49.8	29.8	33.1

Source: The information Website of Development Research Center of The State Council (DRCnet), China Machinery Online.

Table 2 indicates that China's machine tool consumption rose rapidly and the demand grew promptly in the wake of the swift economic development from 2004 to 2010. The rapid expansion of the import was caused hereby. From 2004 to 2008, the machine tool import value accounted for about 50% of the machine tool consumption; in 2009 and 2010, this proportion was 29.8% and 33.1% respectively. This shows the development of China machine tool industry can not meet the needs of the domestic economic development.

2.2 Output and import & export structure of China machine tool industry

By volume, as Table 3 shows, the number of imported CNC machine tools accounted for more than half of the total consumption market for a long term in China. Since 2004, in the wake of the rapid expansion of consumption, the proportion has dropped from 50% to 30 %.

By value, as Table 3 shows, the imported CNC machine tools accounted for 55%, mainly because China could not produce high-performance CNC machine tools and high-performance machine tools were all imported. Owing to the rising price of high-end CNC machine tools, the proportion of the value of imported CNC machine tools in China's machine tool market will be higher, [1].

In the global machine tool market, 33 countries or regions can produce machine tools, including 20 ones that can produce CNC machine tools; only 4 ones (Germany, USA, Japan, Switzerland) of them can produce high-performance CNC machine tools independently. Now, the global annual output of machine tools is about 1 million sets, of which CNC machine tool output reaches 180,000 to 200,000 sets, accounting for 18 to 20%.

Table 3: Volume and Value Proportion of Two Types of CNC Machine Tool in China Machine Tool Market, 2009

Category	Volume Proportion			Value Proportion		
	Domestic product	Imported product	Total Proportion	Domestic product	Imported product	Total Proportion
High-end	2%	28%	30%	3%	63%	66%
Medium-end	18%	21%	39%	12%	19%	31%
Low-end	31%	-	31%	3%	-	3%

Source: The information Website of Development Research Center of The State Council (DRCnet), China Machinery Online

3 Competitiveness of China machine tool industry in the world market

3.1 Development trends of machine tool technology

The production of high-end CNC machine tools reflects technology and prospect of the machine tool industry of a country. By technology, CNC machine tools are divided into high-end, medium-end and low-end ones. High-end CNC machine tools are featured with high speed, high precision, multi-axis control and complex process, [2].

3.1.1 High speed

At present, the feed speed of a high-speed machining center is 80 m / min or even higher. In the world, many automobile manufacturers have used high-speed machining centers to replace modular machine tools. The feed speed of HyperMach machine tools made by Cincinnati Machine can reach up to 100 m / min. It only takes 30 minutes to process a thin-walled aircraft part with a HyperMach machine tool, while it takes 3 hours with a general high-speed milling machine tool and 8 hours with an ordinary milling machine tool.

3.1.2 High precision

High-precision machining technology improves processing efficiency, product quality and market competitiveness, as well as shortens the production cycle. Therefore, high precision has become an eternal theme of the machine tool industry. According to the recent development, the machining accuracy of CNC machine tools is raised by 100% every eight years; the accuracy of general CNC machining tools is enhanced from 10 microns to 5 microns; the accuracy of precision machining centers is improved from 3 - 5 microns to 1 - 1.5 micron; the accuracy of ultra-precision machining centers has reached the nanometer level (0.01 micron).

3.1.3 Multi-axis

Multi-axis CNC machine tools greatly improve the surface accuracy and processing efficiency of three-dimensional curved surface parts. For example, the efficiency of a five-axis machine tool is equivalent to that of 2 sets of three-axis machine tools.

3.1.4 Compound

Composite machining applies several different machining techniques into a machine tool and combines process complex with job complex, so as to complete all the machining sectors of parts in one clamping.

3.1.5 Extreme manufacturing technology

Extreme manufacturing means producing extremely massive, mini-sized or highly-functional devices or systems under extreme conditions or environments.

3.2 International competitiveness of China machine tool

Compared with the development of global machine tool industry, the disadvantages of China machine tool industry are reflected in the weak competitiveness of Chinese enterprises and tiny global market shares. In particular, the high-end CNC machine tools made in China can not meet the demand of varieties and technology in world market, only taking about 1% market share. Chinese enterprises are not good at delivery and services of medium and low-end CNC machine tools; especially it is quite prominent that Chinese CNC parts are obsolete in the world market.

Taking the international financial crisis into account, the data in 2010 are used to illustrate the international competitiveness of China machine tool industry. Table 4 shows the machine tool Trade Specialization Coefficient (TSC) of major countries or regions in 2010. TSC is the ratio of the net export of a certain commodity against the total trade value of such a commodity in a country, calculated as:

$$TSC = (E_{ij} - I_{ij}) / (E_{ij} + I_{ij})$$

E_{ij} stands for the total export value of Commodity j of Country i .

I_{ij} stands for the total import value of Commodity j of Country i .

TSC ranges from -1 to 1. When TSC is bigger than zero, Country i is a net exporter of Commodity j , so Country i has strong competitiveness in the export of Commodity j . When TSC value is smaller than zero, Country i is a net importer of Commodity j , so Country i has weak competitiveness in the export of Commodity j . The higher TSC is, the stronger the competitiveness is. If TSC is -1, Country i only imports Commodity j without export; if TSC is 1, Country i only exports Commodity j without import.

Table 4: Machine Tool TSC in Major Exporting Countries or Regions, 2010

Country or Region	Japan	Taiwan, China	Switzerland	South Korea	China
TSC	0.8944	0.6224	0.5967	0.0750	-0.6717

Table 4 indicates that China had the lowest TSC (-0.6717) in 2010, namely, Mainland China was a net importer of machine tools, and the import value was

much more than the export value; China even had no competitiveness in high-end CNC machine tools. Japan, Taiwan and Switzerland ranked top 3 in the machine competitiveness in the world.

In China, the output volume and value of common machine tools and low-end CNC machine tools with low unit value and low technology level accounts for a larger proportion of the total output of metal cutting machine tools, while the output value of machining centers only accounts for about 1%; in developed countries, the output value of machining centers accounts for about 30% of the total output of metal cutting machine tools, [2].

4 Channels for enhancing the development of China machine tool industry

4.1 Development strategies of China machine tool industry

China machine tool industry needs to focus on innovation, aim at the market demand, improve the corporate governance structure, and ensure effective management of enterprises through establishing and improving the modern enterprise system.

China machine tool industry needs to accelerate the construction of enterprise technology centers, promote the combination of research and production, increase investment in R & D, and enhance the innovation capability of enterprises. When perfecting quality and reliability of CNC machine tools, China machine tool industry regards R & D of high-end CNC machine tools as a starting point to boost the CNC machine tools made in China.

4.1.1 Constructing strategic zones of machine tool R & D and manufacturing

The cluster effect of the global machine tool industry is very obvious that will bring many competitive advantages, such as low operating costs, technology spillover and the cooperation among enterprises in the industrial chain. Compared with major machine tool producers in the world, China machine tool industry is in fragmentation. The establishment of strategic cluster zones is conducive to the competitiveness of China machine tool industry. At present, China can consider to establish strategic machine tool zones in some regions where the basis of machine tool industry is sound and the prospect is promising, such as Liaoning Province and Jiangsu Province.

4.1.2 Setting up the technological innovation system which integrates science research with production

China machine tool industry should make full use of the existing basis to vigorously promote innovation, integrated innovation and re-innovation; strive to

master core technologies with independent intellectual property rights; actively boost the industrial application and market exploration. A new technology or a new product may evolve to a new industry and a new economic growth point.

4.1.3 Making “Going Global” policy to expand international market shares

The domestic demand for machine tools is volatile, so it is hard and risky for machine tool manufacturers if they only focus on the domestic market. In the world, major machine tool manufacturers distribute their products worldwide. China machine tool industry can actively explore the international market to avoid operation risks, and machine tool enterprises should be encouraged and supported to expand the international market and be advocated to introduce foreign advanced technology and management experience [3]. Though foreign countries blockade their high-end CNC machine tool technology into the China market, Chinese machine tool enterprises can achieve advanced machine tool technology and R & D technology through acquisition [4] and invite foreign experts to help them to improve R & D and product quality.

4.1.4 Accelerating to build "Made in China" top brands

Owing to the expansion of powerful multinational corporations and the international transfer of manufacturing industry, it is critical for China machine tool enterprises to build their own top brands. They can develop brand strategies and conduct in-depth research on the cultural patterns represented by brands. In the market competition, brands have become the core elements of success, bringing benefits to the enterprises and the whole society. A number of companies with comparative advantages should be encouraged and supported to accelerate the pace of building their own brands. These enterprises should not only directly absorb and learn from the experience of other foreign enterprises, but also consider their actual situation, in order to be strong and to be well-known international companies with their unique brands.

4.1.5 Adjusting the ownership structure and deepening the management structure reform of state-owned machine tool enterprises

In China machine tool industry, there are many product featured with small scale, a long investment cycle, personalized production and rich producing experiences requirements, which facilitates private enterprises to develop. China machine tool industry is in the rapid development stage, and the development of private companies and their investment will be beneficial to the improvement of the ownership structure reform of China machine tool industry. In China machine tool industry, state-owned enterprises play the key roles; however, the obsolete traditional state-owned enterprise system has been a barrier to the development of China machine tool industry. The deepening of the

operation system reform implemented by state-owned machine tool enterprises, as well as the establishment of state-owned asset management models which are suitable for the market economy and China machine tool industry, will offer the significant micro-foundation for China machine tool industry development.

4.2 Development countermeasures for China machine tool enterprises

Machine tool enterprises can enhance international competitiveness through making efforts in the following aspects:

4.2.1 Improving innovation capability and fostering core competitiveness

Core competitiveness embodies the comprehensive abilities of integrating all resources for specific production goals. The process of cultivating core competitiveness is the process of innovation.

In the machine tool industry featured with the scale advantages and huge market potentials, enterprises should make full use of domestic and foreign technological resources to prompt innovation, and turn innovation achievements into economic profits. The process of cultivating core competitiveness is the process of innovation. In the machine tool industry featured with the scale advantages and huge market potentials, enterprises should make full use of domestic and foreign technological resources to prompt innovation, and turn innovation achievements into economic profits.

With the development of new knowledge, technology, processes and management models, enterprises can improve product quality, develop new products, and provide new services to achieve profits. Enterprises can stipulate effective incentives and management regulations to advocate independent innovation and set up innovation systems. Innovation is essential for cracking the bottlenecks incurred by "irrational product mix" and "extensive operation", so as to change the situation that the critical technology of Chinese enterprises are also introduced from overseas companies as well as to enhance the core competitiveness of Chinese enterprises.

4.2.2 Capitalizing on market turbulence and enhancing enterprises' abilities to resist market risks

Market development and changes bring some troubles to predict the market for enterprises. Without the products needed by the market, companies will lose customers. Therefore, enterprises need to conduct market research, analyze market changes, and develop the strategies of R & D to improve production and sales revenue. Through the foreign investment and overseas technology acquisition, Chinese enterprises can make full use of the international market resources,

strengthen management, and enhance response capabilities in global market.

4.2.3 Creating world famous brands for improving enterprises' reputation in global market

The current market competition lies in top brand competition. A brand has become an increasingly important factor in market. With top brands, enterprises not only value the reputation, but also have good relationship with the majority of clients. A brand reflects the reputation of a company, while reputation is one of core competitiveness. The fiercer the competition is, the more worthy the reputation is. Enterprises need to start from establishing credit mechanisms, improve product quality and services, reduce delivery cycle, strengthen management and service customers in good faith so as to win their trust.

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