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An Analysis of International Competitiveness in Dies and Molds

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Abstract

This paper aims to conduct a comparative study of international competitiveness in dies and molds among major countries by using GCI. The trade data are extracted from the data base of UN Comtrade. The countries that are the primary focus of this paper are India, Brazil, Thailand, China and South Korea. The author conducted a detailed analysis of supply and demand in dies and molds, trends in international competitiveness, and the characteristics of these countries' dies and molds trades from around 1990 to 2014. The paper then provides a comparative study of many countries all over the world where users or suppliers of dies and molds were active in 1994 and in 2014. The following countries were selected: among developed countries, Japan, Germany, Switzerland, the USA, the UK, Italy, France, Spain, Portugal, Sweden, Finland and Russia; among Asian NIEs, Korea and Singapore; for ASEAN, Thailand, Malaysia, Indonesia, the Philippines and Vietnam, and from other countries, China, India, Brazil, Argentina, Mexico, Turkey and South Africa.

Keywords: Dies and Molds, Development Model, Supporting industry, International trade, Supply chain, International competitiveness, Economic development

JEL Classification: C00, D00, F10, O30, O40

1. Introduction

1.1 Purpose and Method of Analysis

This paper aims to conduct a comparative study of the international competitiveness in dies and molds among major countries by using GCI. The trade data are extracted from the data base of UN Comtrade. The HS codes for dies are HS 820720 (Dies for drawing) and HS 820730 (Tools for stamping), Molds are HS 8480. The formula of GCI is as follows. $GCI = (\text{Export} - \text{Import}) / (\text{Export} + \text{Import})$. The GCI ranges from -1 to 1, with values close to 1 indicating strong international competitiveness and close to -1 indicating weak international competitiveness. These GCI values are categorized from “very weak” to “very strong” as shown in Table 1. In UN data, although Taiwan is treated in “Other Asia” for political reasons, the author treats “Other Asia” as “Taiwan” after rational consideration of the dies and molds manufacturing situation in Asia. Even though in this paper “Taiwan” might include small volumes from other Asian economies, this will be ignored because all the other countries making dies and molds at significant volumes are definitely listed in the UN database.

Table 1. International Competitiveness of each GCI values

Value of GCI	International competitiveness	Situation of imports / exports
Over 0.75	Very Strong	Most of the applicable items are for exports, and there are very few imports.
0.50 ~ 0.74	Strong	Many of the applicable items are for exports, and there are few imports.
0.10 ~ 0.49	Slightly Strong	There are comparatively more exports.
-0.09 ~ 0.09	Moderate	Exports and imports are almost the same.
-0.10 ~ -0.49	Slightly Weak	There are comparatively more imports.
-0.50 ~ -0.74	Weak	Many of the applicable items are imports, and there are few exports.
Below -0.75	Very Weak	Most of the applicable items are imports, and there are very few exports.

Author

Countries which are the primary focus of this paper are India, Brazil, Thailand, China and South Korea (hereinafter “Korea”). India and Brazil started industrialization earlier than the others and they have a long experience of making dies and molds. In Thailand, they have made efforts to expand their automobile industry and their ICT industry. Companies say that recently they have been able to procure high-quality dies and molds from the domestic market. In China, the recent progress of industrialization is remarkable. The development of the domestic dies and molds industry is also conspicuous for its speed of development. Korea developed from early times in Asia like Taiwan or Singapore following Japan after WWII.

In this paper, the author reports a detailed analysis of supply and demand in dies and molds, and trends in international competitiveness from around 1990 to 2014 in these selected countries. The paper then provides a comparative study of many countries all over the world where users or suppliers of dies and molds are active.

1.2 Basic Development Models for Dies and Molds

As mentioned in another paper in this special issue, four models in the development stages of the dies and molds industry have been suggested, as shown in Fig 1. For countries who want to develop through industrialization, it is important to create a structure to make and supply high quality dies and molds within their countries in order to enhance their productivity, product quality, R&D, and added value. The ideal for emerging counties is for there to be a positive correlation between *time*, which is an alternative variable of the *progress* of dies and molds users such as the automobile and ICT industries, and *progress* in the dies and molds industry (Leaped Model). When the supply side cannot correspond to the increase in demand for quality and volume, the correlation will be negative (Dilemma Model).

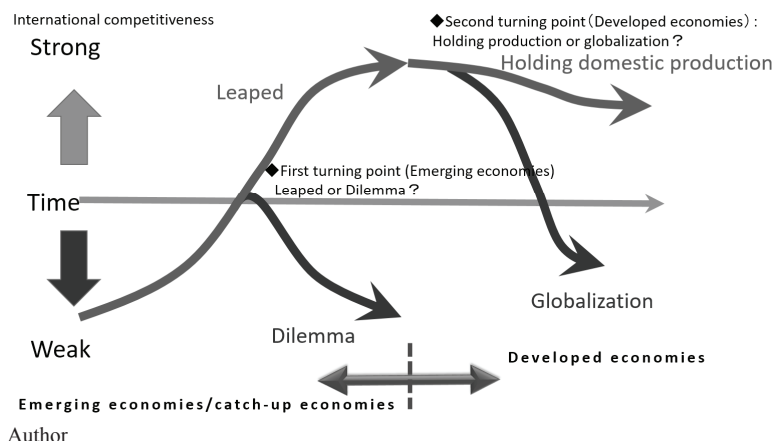


Figure 1. The Development Model for Dies and Molds

With increased globalization in production, R&D and procurement, the interpretation and understanding of GCI values will be different in developed countries from that in emerging countries. When countries keep the domestic production of dies and molds at a certain volume after their dies and molds industries have developed successfully, although the GCI value will gradually decrease because of globalization, the GCI value may remain “strong” (the Holding Domestic Production Model). On the other hand, when globalization has been fairly advanced and the domestic production of dies and molds has shrunk, the GCI value may drop to “weak” (the Globalization Model).

2. The International Competitiveness and Demand Supply of Dies and Molds in India, Brazil, Thailand, China and Korea

2.1 India

India is one of the world’s largest countries. In 2014, according to the World Bank, the population was almost 1.3 billion people, the 2nd highest in the world, the area of land was 3.3 million km², the 7th largest in the world and nominal GDP was 2 trillion USD, 9th in the world. With its large population, GNI per capita of 1,570 USD has not been able to reach the low/medium income economy level. However it had achieved rapid growth from 450 USD in 2000.

A major and leading manufacturing sector in India has been the automobile industry, which is a major user of dies and molds. India is a country with a long history of automobile production among Asian countries. The USA’s affiliated automobile manufacturers started full scale production in the 1920’s. Automobile production by local companies in India started in the 1940’s. In the 1950’s, they introduced development policies for a local automobile industry, such as localization for automobiles and parts, a preferential policy for small manufacturers, and the regulation of large or foreign affiliated companies. These policies made Indian manufacturers uncompetitive, production capacity and technologies stayed sluggish, and international competitiveness decreased. Although India’s automobile industry was significantly behind global technological trends, it is true that the government’s policies enabled India’s local manufacturers to grow and the basic technologies of automobile production were accumulated. After the economic liberalization of 1991, the Indian automobile industry grew rapidly. According to OICA, automobile production was 3,840 thousand units in 2014, making India the 6th largest producer in the world with a world share of 4.3%. Now,

India is a major automobile producing country. The Indian government considers the automobile industry to be an important industry for economic development and job creation, and they would like it to grow and become the world’s automobile R&D center. They introduced “The Automotive Mission Plan 2006-16,” which focused on fostering the automobile industry. Now, they have introduced a new policy called “The Automotive Mission Plan 2016-26.”

In this way, they would like to develop the Indian automobile industry, and as the industry expands and becomes more competitive, demand for high-grade dies and molds has become much bigger. However, Indian dies and molds suppliers do not have sufficient ability to supply high-grade dies and molds in QCD (Quality, Cost, and Delivery), according to my field survey. Users have to import dies and molds. India is still on its way to attaining global standards in the precious high-grade segment of the dies and molds industry, although India has basic skills and technologies for dies and molds making, and dies and molds training flourishes. Although the ability to make and supply high-grade dies and molds is improving, as demand expands, the tendency to depend on imports is still high because of insufficient internal supply.

(1) India’s Trade in Dies and Molds

As mentioned above, domestic high-grade dies and molds suppliers do not meet the demand for expansion in quality and quantity. Imports are very much larger than exports. There are domestic Indian companies which can make high-grade dies and molds. The author visited dies and molds companies in 2015 and 2016 and found that some of them had gained the ability as high-class world dies and molds producers. The problem is that the number of such world class dies and molds companies is insufficient. Added to this, many of them supply only their group companies or are in-house, and they do not sell outside markets. As demand for high-grade dies and molds expands, imports increase (Fig. 2).

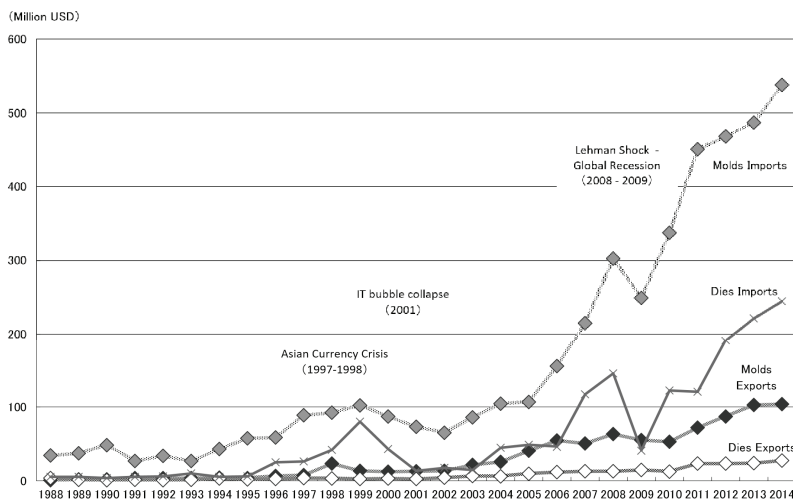


Figure 2. The Trade in India’s Dies and Molds (1988~2014)

Data : Calculated using trade data from the UN comtrade database
 Note: The value of molds is for HS 8480. The value of dies is the sum of HS 820720 and HS 820730.

Fig. 3 shows the trade surplus and deficit for India’s dies and molds trade in India. The trade deficit in both dies and molds expanded in the 2000’s when high-grade dies and molds demand

expanded. In 2009, we can see a temporary improvement in the situation, which was caused by a temporary reduction in imports because of the financial crisis caused by the bankruptcy of Lehman Brothers (hereinafter the Lehman shock), as can be seen in Fig. 2. After that time, imports of dies and molds expanded, while the deficit also expanded.

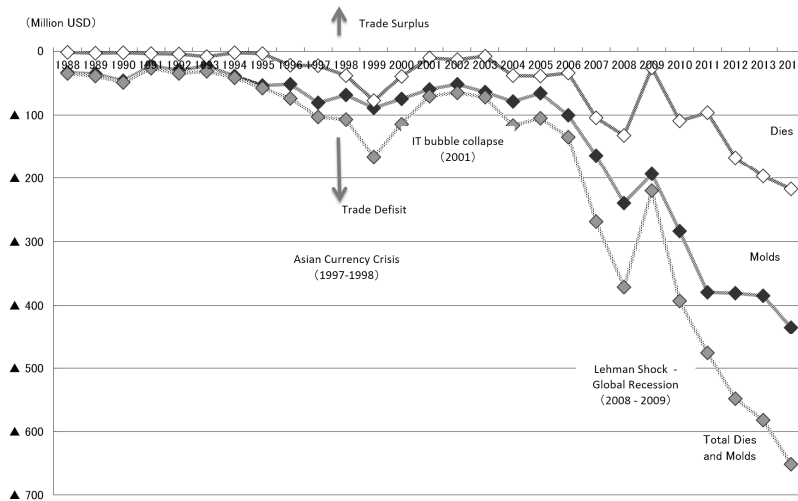


Figure 3. The Trade Surplus and Deficit in India’s Dies and Molds (1988~2014)

Data and notes are the same as for Fig. 2.

(2) India’s International Competitiveness in Dies and Molds

Fig. 4 shows the trend in GCI values, which indicates India’s international competitiveness in dies and molds. GCI values have remained minus in both dies and molds from 1988 until 2014. In 2014, GCI values were -0.7 for molds, -0.8 for dies and -0.7 in total. India’s international competitiveness in dies and molds was in a disadvantageous position until recently.

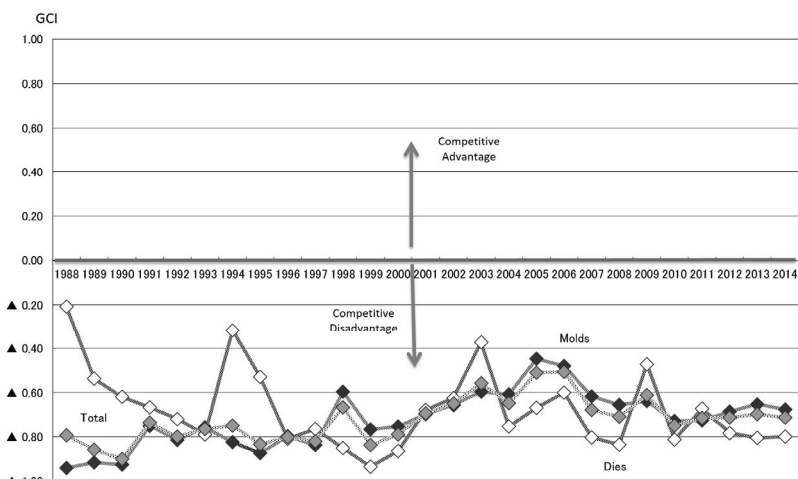


Figure 4. International Competitiveness of India’s Dies and Molds (1988~2014)

Data and notes are the same as for Fig. 2.

(3) Major Partners in India's Dies and Molds Trade

① Molds

By observing the import partners of India's molds trade since around 1990, the major partners were Japan or Taiwan until around 2000. After 2000, the presence of Korea and China increased rapidly. In 1990, the major share of molds imports was occupied by Japan and Taiwan, and their total share was around 40%. In 2010, the total share of Korea and China reached nearly 50%, while that of Japan and Taiwan fell to below 20%. As of 2014, imports from China and Korea increased further, and China became India's number 1 import partner. In 2014, the major partners in India's molds imports and their shares were China at 32%, Korea 26%, Malaysia 8%, Taiwan 7%, and Japan 6%. The total share from China and Korea alone reached nearly 60%.

Although India's molds exports have gradually been increasing, as is shown in Fig. 2, this amount is small compared to their imports. Of the dies and molds companies that the author visited, there exist export companies exporting molds to global companies in the USA or Europe, but their number is small. The statistics for molds exports are thought to include a certain volume of international transactions among the group companies of global manufacturers if we consider the major export partners and the author's interviews with dies and molds players. In 2014, the major export partners of India's molds and their share were Nigeria 7%, Japan 7%, USA 7%, Malaysia 5%, and Germany 5%.

② Dies for Stamping

Concerning India's dies imports, the author would like to look at HS 820730 (tools for stamping), because this is a major part of the dies industry in many countries, including India. Hereinafter, the author will use "dies" to mean "tools for stamping" when referring to "major trade partners".

In the 1990s, India's major partners for imported dies were Japan, Italy and Germany. In 1990, the biggest import partner was Japan, with a 46% share. In 2000, Japan was the top import partner, and its share reached 75%. In the 2000s, the presence of Korea grew rapidly. Of course, although one reason for this was the improvement in Korean dies, another big factor was the expansion of the automobile production of Hyundai Motors, which is a famous Korean company. According to the author's field survey, many Indian dies imports are for automobile production because Japan and Korea are major dies import partners. Recently, the degree of dependence of Japanese auto manufacturers in India upon Japanese dies has decreased, according to interviews. In 2014, major dies import partners and their shares were, first, Korea 57%, then China 20%, Taiwan 8%, Italy 5%, and Japan 3%. From Korea and China alone, the share was nearly 80%.

Die exports from India are quite small, as can be seen in Fig. 2. Export partners depend on the circumstances. As of 2014, the major partners and their shares were the UK 36%, Germany 22%, the USA 4%, Bangladesh 3%, and Switzerland 2%.

2.2 Brazil

Brazil is a large country in South America. In 2014, its population was 200 million, the 5th highest population in the world. The land area is 8.5 million km², the 5th largest in the world, and nominal GDP is 230 billion USD, 7th in the world. GNI per capita is 11,530 USD, which classifies Brazil as a medium-high income economy. Although GNI per capita was 3,789 USD in 2000, it reached 13,238 USD in 2011, which denotes a high income economy. However, because of the economic slackening since then, Brazil fell below this standard.

One of the leading manufacturing industries of Brazil is the automobile industry as is the case in India. It is also famous for Embraer, which is a world famous airplane manufacturer. The

automobile industry increased production during the economic growth of the 2000s. Although automobile production was 1.68 million units in 2000, it increased to 3.74 million units in 2013, but recently, because of the economic slowdown, production fell to 3.15 million units in 2014.

The Brazilian government strengthened its regulations to protect its domestic automobile industry. The government announced in September 2011 that 30% would be added onto the IPI (a tax for industrialized products), for domestic automobile production and imported automobiles. This was except for automobiles which met certain requirements linked to domestic production and domestic procurements. Although this policy ended in December 2012, it was carried over in a new automotive plan “Inovar-Auto” from October 2012. From 2013 to 2017, while 30% continues to be added to IPI unless domestic producers meet certain requirements linked to domestic production or domestic R&D. Thus, the tendency to protect the domestic industry has intensified.

The skills and technologies for making dies and molds were taken to Brazil by immigrant or automobile manufacturers from European countries. The author visited some domestic dies and molds manufacturers in 2012 and 2014. They were sincere and enthusiastic about manufacturing. Skills and technologies were accumulated in factories, and training in making dies and molds flourished. Many of these manufacturers admitted to a market threat from China. Actually, imports from China have been increasing, which confirms this threat. The main reason for this is a decline in the international competitiveness of Brazilian dies and molds. By referring to QCD (Quality, Cost, Delivery), the competitiveness of cost and delivery is inferior in Brazil. Many Japanese dies and molds users in Brazil said “Brazilian technology is not bad, but the prices are high, and delivery is slow. Sometimes it is cheaper and faster to import dies and molds from countries on the other side of world, such as China, Korea or Thailand.” The main factor in the decline of cost competitiveness is the “Brazilian Cost” which is the Brazil-specific high cost mix of factors that include taxes, labor costs, delivery costs and security costs. To enhance international competitiveness, it is important to innovate. To do this, it is sometimes very important to buy new machinery because that embodies the fruits of fresh innovation (Baba 2013). In Brazil, high import duties or high interest rates have prevented companies from taking out investment loans from banks. As a result, Brazil has lagged behind world standards in technology, and it has fallen into a situation where it cannot reduce production time and cannot produce the high-grade dies and molds that users need.

(1) Brazil’s Trade Situation in Dies and Molds

In Brazil, suppliers of high-grade dies and molds cannot provide enough quality and quantity to meet the expanding demands of users such as the automobile industry. This is because imports of dies and molds are much bigger than exports (Fig.5). As demand increases, imports increase further, because the domestic market cannot keep up with demand.

Fig. 6 shows the trade surplus and deficit for the dies and molds trade in Brazil. In the latter half of the 2000s, the trade deficit in both dies and molds became bigger because of the increase in imports. This was the period when each automobile manufacturer introduced new models and Hyundai’s big expansion of automobile production was supported by favorable economic growth.

After 2012, trade deficits in dies and molds trade fell because imports fell. There are several possible reasons for this, such as the effect of Inovar-auto, the introduction of new models, the expansion of domestic procurement, and a fall in demand caused by a slackening economy. More research is needed to clearly identify the trends and reasons.

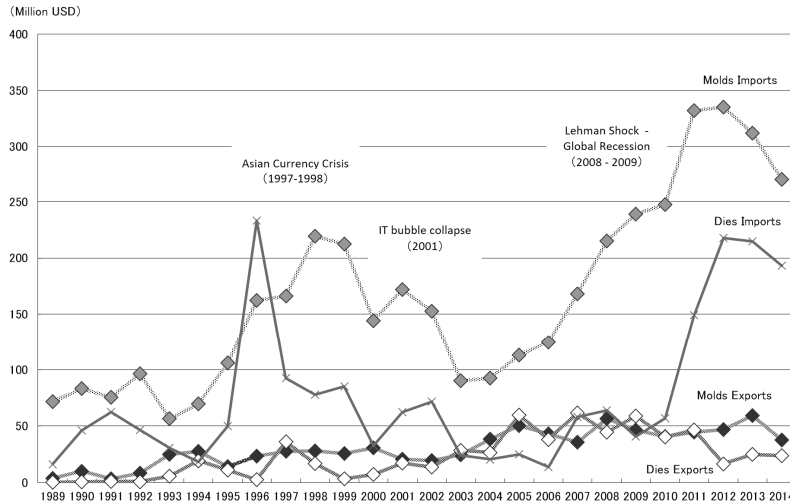


Figure 5. The Trade Situation for Brazil’s Dies and Molds (1989~2014)

Data and note are the same as for Fig. 2.

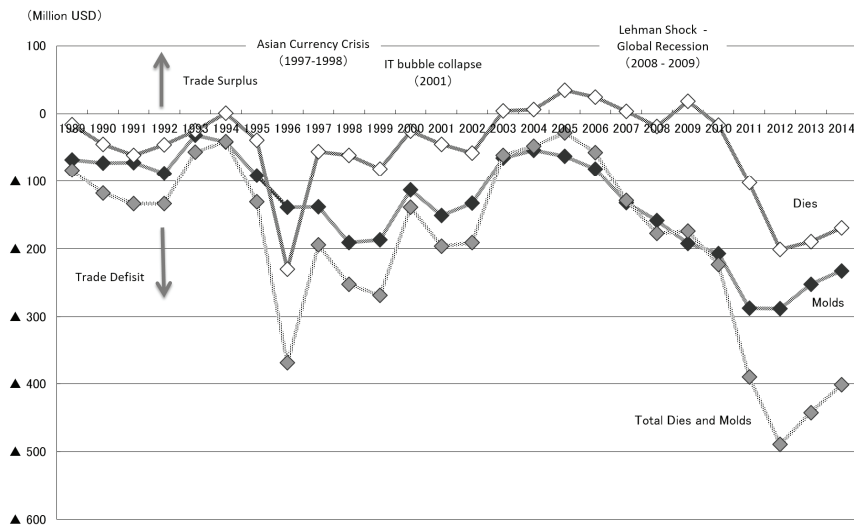


Figure 6. The Trade Surplus and Deficit in Brazil’s Dies and Molds Trade (1989~2014)

Data and notes are the same as for Fig. 2.

(2) Brazil’s International Competitiveness in Dies and Molds

Fig. 7 shows the trend in GCI values, which indicates Brazil’s international competitiveness in dies and molds. GCI values generally had an upward trend with some fluctuation from 1989 until around 2005 in both dies and molds. Regarding dies, GCI showed plus values in 1994, from 2003 to 2007, and in 2009. This was a period of comparative advantage in dies. However, GCI values for dies dropped dramatically between 2010 and 2012. The values of molds also dropped from 2006 to 2012.

From 2012 to 2014, the situation remained stable but was very weak. In 2014, the GCI values were -0.8 for molds, -0.8 for dies and -0.8 in total. The international competitiveness of Brazil's dies and molds dramatically dropped in the latter half of 2000, and that situation has remained until now. This looks like a dilemma model.

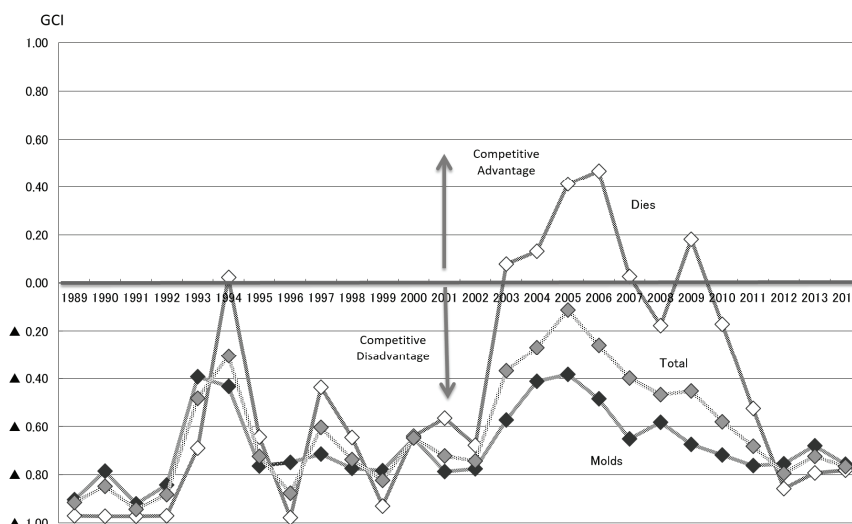


Figure 7. International Competitiveness of Brazil's Dies and Molds (1989~2014)

Data and notes are the same as for Fig. 2.

(3) Major Partners in Brazil's Dies and Molds Trade

① Molds

From around 1990 until the first half of the 2000s, the major import partners in Brazil's molds were Italy, Germany, Japan and Taiwan. These countries had moved into Brazil and were producing automobiles.

Since the latter half of the 2000s, molds imports from China and Korea have risen dramatically. Mold imports from Korea ranked 5th in 2003, but after 2010 they formed the 2nd largest share. Hyundai Motors moved to Brazil in 2005. They rapidly increased their automobile production, and held the 4th largest share in Brazil's automobile market (240 thousand units and 7% of the share). This may be an important factor in the increase in molds imports from Korea. On the other hand, molds imports from China ranked 4th in 2005, but were top from 2006 to 2014. There are no Chinese automobile manufacturers operating on a large scale in Brazil. Companies import Chinese molds because of the cost advantages. People in Brazil's dies and molds industry felt a sense of danger from this rapid increase in China's imports. They founded "ABINFER," which is the Brazilian association of the dies and molds industry, in 2011. In 2014, the major partners in Brazil's molds imports and their shares were China 33%, Korea 14%, Germany 9%, Italy 7%, and Japan 7%. The total share from China and Korea reached nearly 50%.

Molds exports are quite small compared to imports. In 2014, major trading partners in Brazil's molds exports and their shares were Argentina 38%, the USA 11%, Mexico 6%, Colombia 6%, and Chile 6%. Many of these countries are near Brazil or members/affiliate members of "Mercosur" (the Common Market of South America).

② Dies for Stamping

The major dies (HS 820730) import partners were Japan, Italy, Argentina, German, Spain, the USA and France from the 1990s to the early 2000s. Of these, the portion of imports from Japan was great. Japan ranked 1st 12 out of 25 times between 1990 and 2014. The other countries ranked 1st in this period included Italy 4 times, Argentina 4 times, Germany 2 times, Spain 2 times and the USA once. Japan continued to come 1st between 2011 and 2014. The presence of China and Korea has also increased, as happened with molds, from the latter half of the 2000s, when dies imports dramatically expanded. Korea was ranked in 4th in 2005, 2nd in 2011 and 3rd from 2012 to 2014. China was ranked 3rd in 2007, and has remained 2nd from 2012 to 2014. In 2014, major dies import partners and their shares were Japan 39%, followed by China 14%, Korea 14%, Italy 11% and the USA 6%. The reason for the present increase for China and Korea is thought to be the same as that for molds.

Die exports from Brazil are quite small, as can be seen in Fig. 5. In 2014, major partners and their shares were Mexico 46%, the USA 31%, Argentina 14%, and Chile 2%.

2.3 Thailand

Thailand is one ASEAN member that concentrated its efforts on industrialization, and their efforts have borne fruit. In 2014, the population was 67.7 million people, the land area is 510 thousand km², nominal GDP was 400 billion UDS, and GNI per capita was 5,780 USD, which means that the country is classified as a high-middle income economy.

Thailand is a country where the automobile industry has prospered. The country's aim is to be the "Detroit" of Asia. In 2014, automobile production was 1,880 thousand units (12th in the world) and its world share was 2.1%. Although it stayed in the top 10 until 2013, both production numbers and share dropped in 2014. Thailand's ICT industry is also successful; it is the world's top supplier of HDs. Thus, demand for high-grade dies and molds for the automobile and ICT industries is big in Thailand. According to interviews with Japanese manufacturers in Thailand, it has become possible to procure almost all the required high-grade dies and molds from domestic suppliers. They say that they can procure progressive dies for high-tension steel, which is said to be difficult to design and make, from the domestic market. Moreover, they say that they export high-grade dies and molds to locations all over the world and not only to ASEAN countries. The author heard the same stories in Vietnam, India and Brazil. They say that only a few extra high-grade molds and dies remain in the exclusive hands of Japan.

(1) Thailand's Trade Situation in Dies and Molds

By analyzing the trade statistics, we see a different story to the one above. As is shown in Fig. 8, as economic and industrial growth increases, imports of dies and molds also increase. Although imports temporarily fell in the latter half of the 2000s because of the Lehman shock and the ongoing global recession, since then their imports have rapidly increased both for dies and molds. Although we observe an increase in exports as is consistent with the author's interviews, the volumes are not as large as those for imports, and the increase in exports stopped after 2011.

By observing the trade surplus and deficit in the dies and molds trade in Fig. 9, we can see the increase in the deficit after 2010 because of the rapid increase in imports. Although the deficit temporarily fell in 2013, it increased again in 2014.

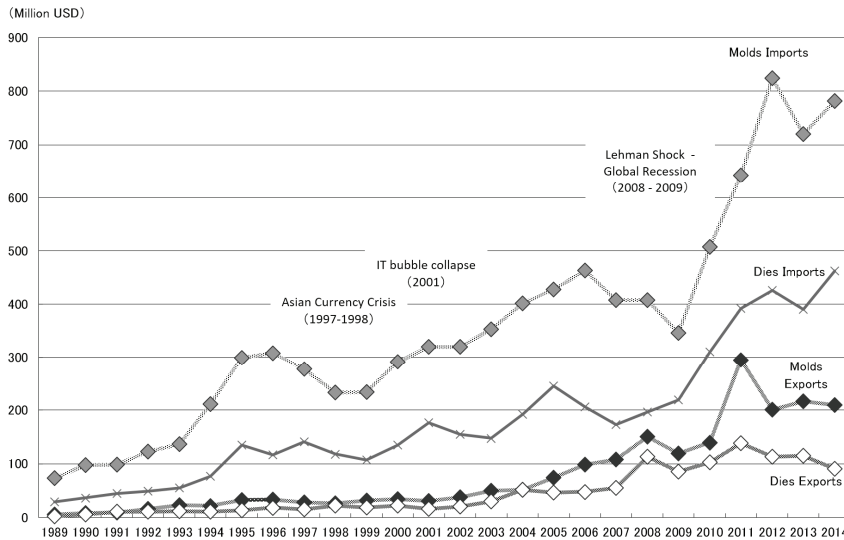


Figure 8. The Trade Situation in Thailand’s Dies and Molds (1989~2014)

Data and notes are the same as for Fig. 2.

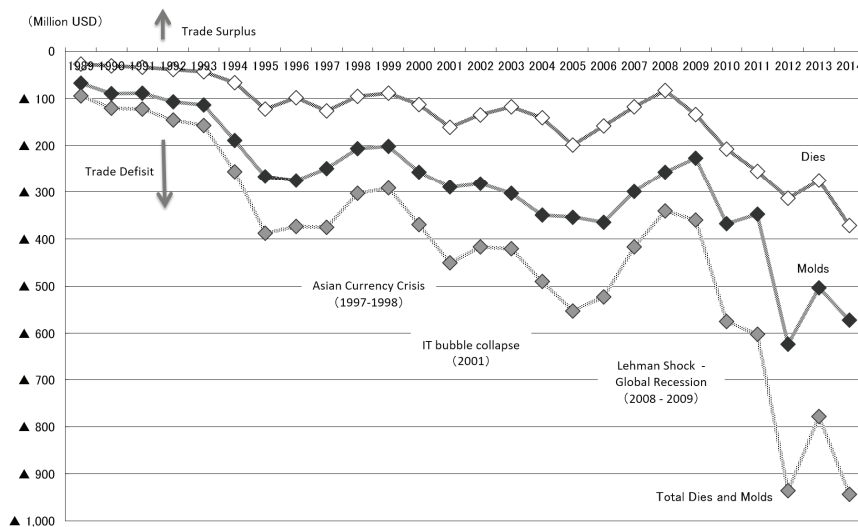


Figure 9. The Trade Surplus and Deficit for Thailand’s Dies and Molds Trade (1988~2014)

Data and notes are the same as for Fig. 2.

(2) Thailand’s International Competitiveness in Dies and Molds

Fig. 10 shows the trend in GCI values, which shows Thailand’s international competitiveness in dies and molds. The GCI value remained around -0.8 from 1990 to the early half of the 2000s. This means international competitiveness was quite weak. In the latter half of the 2000s, this improved to around -0.5, peaking in 2008 before it returned to a tendency to decline. The reason for this is the

increase in imports and a drop in exports in the 2010s. By analyzing the trade statistics, the author has identified that the international competitiveness of Thailand’s dies and molds is weak.

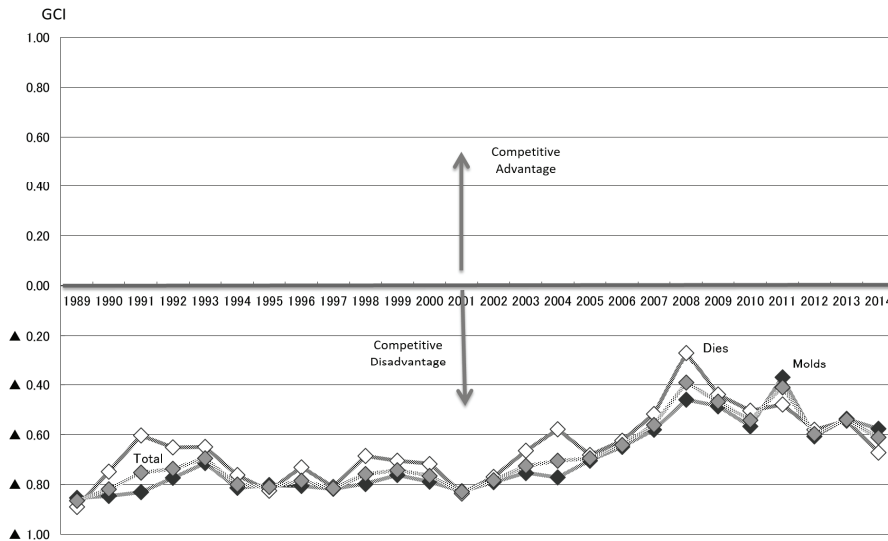


Figure 10. The International Competitiveness of Thailand’s Dies and Molds (1989~2014)

Data and notes are the same as for Fig. 2.

(3) Major Partners for Thailand’s Dies and Molds Trade

①Molds

The particular thing about Thailand’s molds import partners is that Japan has remained the top partner since 1990. In 1995, the Japanese share of import molds was over 60%, although afterwards it gradually decreased until the share reached nearly 50% in 2010. Many Japanese automobile manufacturers and ICT manufacturers moved to Thailand. When they cannot procure molds from the domestic market, they import them from Japan. Recently the shares of China and Korea have increased, and the Japanese share has decreased. The multi-polarity of molds imports has developed recently. Since 2010, ranks and shares have been first Japan, 2nd China, 3rd Korea, and 4th Taiwan. In 2014, Japan was 35%, China 28% and Korea 13%. The total from only these three countries was nearly 80% of Thailand’s total molds imports.

Regarding Thailand’s molds exports, these have stayed large for Japan. This is thought to include a large number of transfers within Japanese group companies, according to interviews with Japanese manufactures. On the other hand, there has been an increase in exports to other countries, according to interviews. In 2014, the major export partners and shares for Thailand were Japan 27%, the USA 20%, India 9%, Indonesia 9% and China 7%.

②Dies for Stamping

The unique point regarding Thailand’s major dies (HS 820730) import partners is the strong presence of Japan, which is similar to the situation with molds. In 1995, nearly 80% of Thailand’s dies imports were from Japan. After the 2000s, Thailand increased their imports of dies from other countries such as Malaysia, China and Korea, but the proportion of these countries’ share was small compared to that of Japan. In 2014, major dies import partners and shares were Japan 59%,

followed by Korea 23% and China 5%. Although the share from Korea increased in 2014, Japan still has a strong presence. The share from China is still small. However, the share from Japan has gradually decreased and those from Korea and China have gradually increased. Overconcentration on Japanese production may change to multi-polar procurement as has happened with molds.

Regarding Thailand's exports of dies, until 2000, Japan's share was the largest. This was thought to be due to transfers within group companies. With the progress of Thailand's domestic dies and molds industry and the increase in the worldwide procurements of global companies, the situation has changed. As of 2014, the major partners and shares of Thailand's dies exports were Mexico 22%, followed by the USA 16% and Pakistan 10%.

2.4 China

China is a big country. As of 2014, the population was 1.36 billion people, the largest in the world, the land area is 9.6 million km² the world's 4th largest, nominal GDP was 10.4 trillion USD, second in the world, and GNI per capita is 7,400 USD, which classifies the country as a high-medium income economy. Generally speaking, it is difficult to raise the GNI per capita of countries with a large population quickly, but in China's case it was a different story. GNI per capita was only 330 USD in 1990. It broke 1,000 USD in 2001, 2,050 USD in 2006, 3,070 USD in 2008, 4,300 USD in 2010, 5,000 USD in 2010, and 6,710 USD in 2013. This shows China's rapid economic growth.

Today, China is a major power in automobile and ICT production. It is said to be the factory of the world. Automobile production in 2014 was 2.37 million units, which is the largest in the world (a world share of 26.4%). China is also successful in ICT.

According to a field survey, the high-grade dies and molds industry was not fully developed in China until the early half of the 2000s. A huge market and increased production pushed dies and molds manufacturers of many countries to go to or to assist with technology in China from Japan, Europe, the USA, Taiwan, Hong Kong, Singapore and so on. Then the dies and molds industry in China grew rapidly. Huge demand for dies and molds led to a special type of dies and molds production style in China. Normally, dies and molds are produced one by one, especially designed and customized for a specific order. In China, some companies mass-produce dies and molds themselves. Normally dies and molds are produced by multi-skilled workers in many countries. Many single skilled operators perform each process in parallel. Normally in other countries, in order to make dies and molds, there is a need for many multi-skilled workers. In China, because job hopping is very normal, this style suits the situation.

High grade molds for plastic molding and aluminum die-casting can be procured domestically, except for a small portion of special high-grade molds. Regarding dies, China depended on imports until the middle of the 2000s, recently it has increased domestic procurement.

(1) China's Trade Situation in Dies and Molds

In China, the automobile and ICT industries grew rapidly after the latter half of the 1990s and demand for high-grade dies and molds rapidly expanded. At first, the industries depended on imports or foreign-affiliated dies and molds manufacturers. Then the domestic dies and molds industry grew rapidly. As is seen in Fig. 11 and Fig.13, trade for both dies and molds ran deficits in the 1990s. Since the middle of the 2000s, Chinese exports of molds have exceeded imports. The increase in China's molds exports in the 2000s was remarkable. In the 2010s, dies exports have also started to increase rapidly.

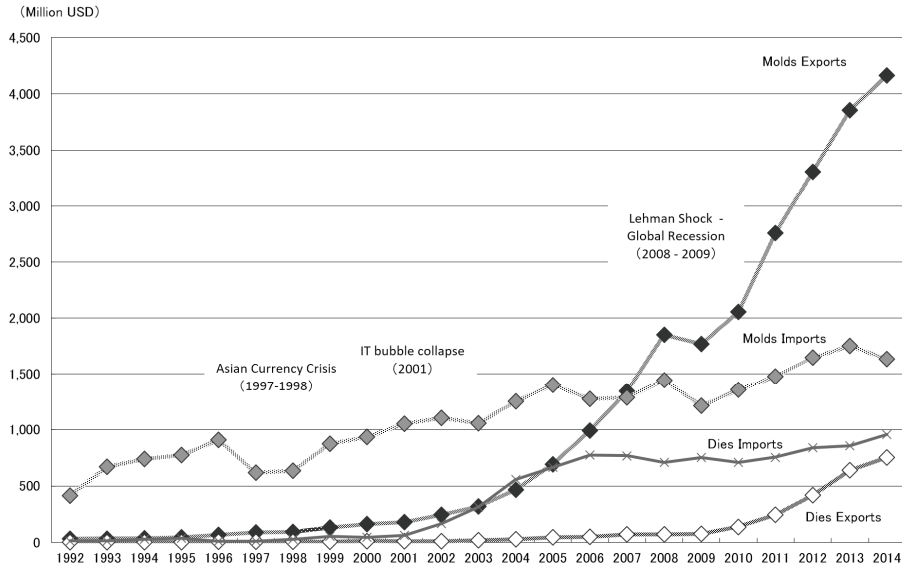


Figure 11. The Trade Situation for China’s Dies and Molds (1992~2014)

Data and notes are the same as for Fig. 2.

As is seen in Fig. 12, the molds trade began to record a surplus in 2007, then the surpluses increased year by year. Regarding the trade in dies, deficits increased in the 2000s. The automobile industry grew in this period. The demand for high grade dies increased but China could not procure high grade dies to meet the domestic demand. Therefore they had to import high-grade dies. In the latter half of the 2000s, the trade in dies recorded a deficit. In the 2010s, exports of dies have rapidly increased. The trade deficit for dies has recently fallen year by year.

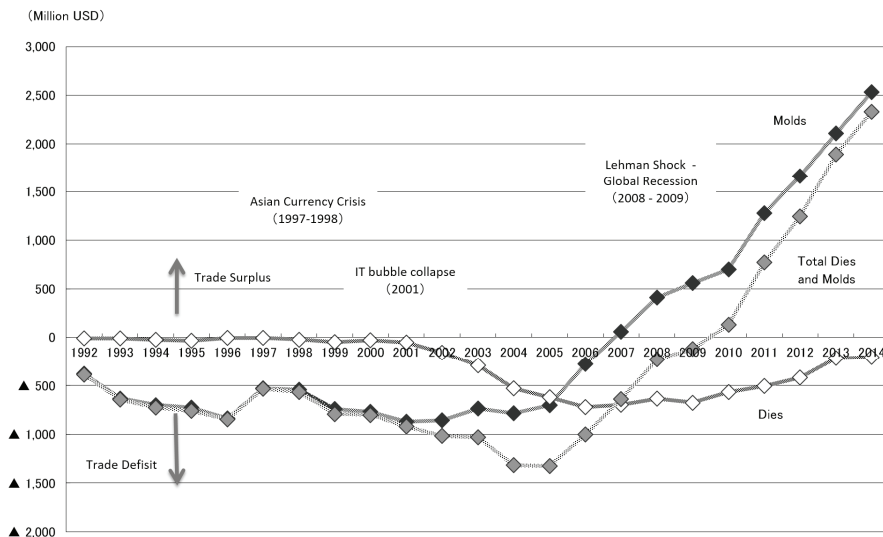


Figure 12. The Trade Surplus and Deficit in China’s Dies and Molds Trade (1992~2014)

Data and notes are the same as for Fig. 2.

(2) China's International Competitiveness in Dies and Molds

In the 1990s, the international competitiveness of China's dies and molds was quite weak as is seen in Fig 13. They needed to import or buy high grade dies and molds from the affiliates of foreign manufacturers. In the 2000s, the international competitiveness of China's molds rapidly improved. As is seen in Fig. 13, in 2000 the GCI value of molds was -0.7, which meant that international competitiveness was weak. In 2007, it turned positive and by 2014 it had risen to 0.44. In the 2000s, the international competitiveness of China's molds had improved remarkably.

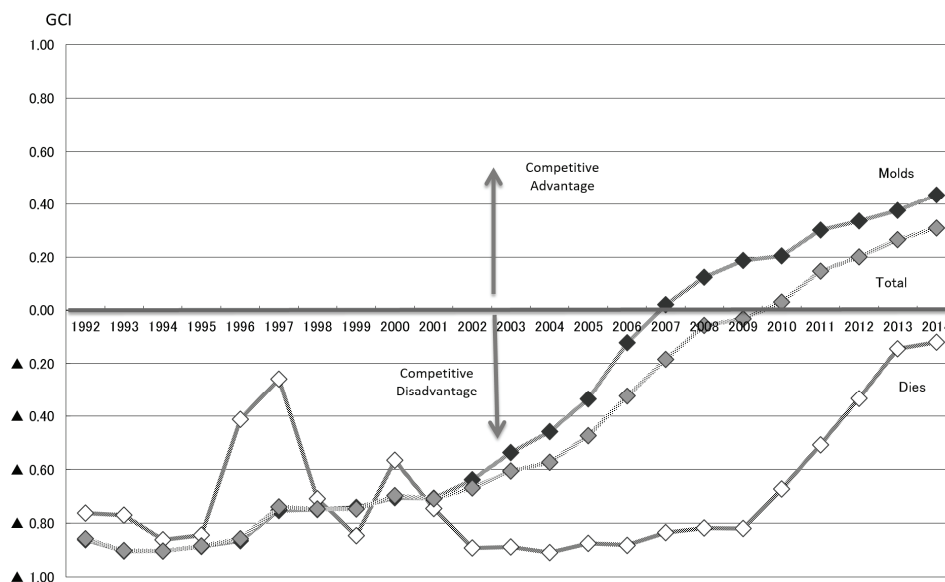


Figure 13. International Competitiveness of China's Dies and Molds (1992~2014)

Data and notes are the same as for Fig. 2.

Regarding dies, these were still weak in the 2000s. As is seen in Fig 13, we find an increase in dies' international competitiveness from 1996 to 1997. In this period, dies imports decreased and exports increased temporarily because of the Asian Currency Crisis. In the 2000s, the demand for high-grade dies increased and there was more of a reliance on imports again. GCI values stayed low at around -0.9, which resulted in a great dependence on imports. In the 2010s, GCI values have rapidly improved. The international competitiveness of dies dramatically changed from being very weak to being moderate. The international competitiveness of dies may become strong, as has happened to molds recently.

(3) Major Partners for China's Dies and Molds Trade

① Molds

The major Chinese import partners for molds have been Japan, Taiwan and Korea. One reason for this is that many manufacturers have moved from such countries to China. As of 1995, imported molds from Taiwan constituted the largest share at around 30%. In 2010, Taiwan's share dropped to around 10%. There are many Taiwanese manufacturers who have moved their molds production to China. Korea's share of imports was only 5% in 1995. Then it grew to more than 20% in 2010. As the international competitiveness of Korean molds improved, many countries, including China,

imported from Korea. In 2013, imports from Korea exceeded those of Japan. In 2014, Korea had a 25% share, Japan 18%, China 13%, Taiwan 12% and Germany 9%. China became 3rd because it usually re-imports molds in south China for the tax benefits that export-oriented companies can receive.

Regarding molds exports from China, the No. 1 export partner continued to be Hong Kong from 1995 until 2014. The reasons are as follows. Exports from Chinese molds take place through Hong Kong to Guangdong. There are many headquarters or regional headquarters in Hong Kong, and they usually trade between Guangdong and Hong Kong to reduce their taxes, because taxes for export-oriented manufacturers are very cheap, and it was cheaper to procure molds through re-imports than to procure them directly in Guangdong. As of 2014, the major export partners and shares after Hong Kong were the USA 10%, Japan 8%, Germany 6% and India 5%.

②Dies for Stamping

Regarding dies imports, previously Japan had the largest share. Recently, imports from Korea have increased and in 2014 they overtook Japan to become the top dies import partner for China. Recently, imports from Germany have also increased. As of 2014, the major dies import partners and their shares are Korea 34%, followed by Japan 31%, Germany 12%, Taiwan 8% and Spain 4%. Korea, Japan and Germany constitute 65% of Chinese dies imports.

Many Chinese dies exports go through Hong Kong, like for molds until the middle of the 2000s. Recently, the situation has changed. In 2014, China's major export partners and their shares were the USA 17%, India 8%, Germany 8%, Japan 8%, and the UK 7%.

2.5 Korea

In 2014, the population of Korea was 50 million people, the land area is 100 thousand km², and the nominal GDP was 1.4 trillion USD, the 13th largest in the world. GNI per capita was 27,090 USD which made the country a high income economy. Korea is a country whose economy was able to grow very much as a result of industrialization after WWII.

Now, Korea hosts one of the world's leading automobile and ICT industries. There are famous automobile companies such as the Hyundai Motor group, Renault Samsung Motors, and GM Korea, while Samsung electronics and LG electronics are very famous in the ICT industry. Their products have a high international reputation. Automobile production in 2014 was 4.52 million units, 5th in the world with a share of 5.0%. Korea's manufacturers hold the world's top share in many products. In Korea, progress in supporting industries is also conspicuous. They focused on the dies and molds industry from early times as already being important for production in the 1970s. The Korean government supports the introduction of technology with special training and industrial development in dies and molds. As was mentioned in the cases of India, Brazil, Thailand and China, today Korea has become a world power in the supply of dies and molds.

(1) Korea's Trade Situation in Dies and Molds

Korean exports of dies and molds have rapidly expanded since the middle of the 1990s. At first, exports of molds increased and recently dies exports have also expanded, as is seen in Fig. 14. Korea was a country with a deficit in the dies and molds trade until the latter half of the 1980s. They relied on high-grade dies and molds from Japan. It was said that the deficit in the dies and molds trade was one of the big factors in the trade deficit with Japan. Today, Korea can procure almost all types of dies and molds from the domestic market except those of highly specialized grades. As can be seen in Fig. 14, imports of both dies and molds are extremely small compared to exports.

Today in Korea, trade in both dies and molds runs a surplus that is increasing year by year, as can be seen in Fig. 15. Although the trade in molds began to record a surplus in 1990, the deficit in dies continued until the latter half of the 1990s. The skills and technologies in the case of dies were more difficult to obtain compared to molds (Baba 2005). The dies trade started to record a surplus in 2000, and this is now expanding year by year.

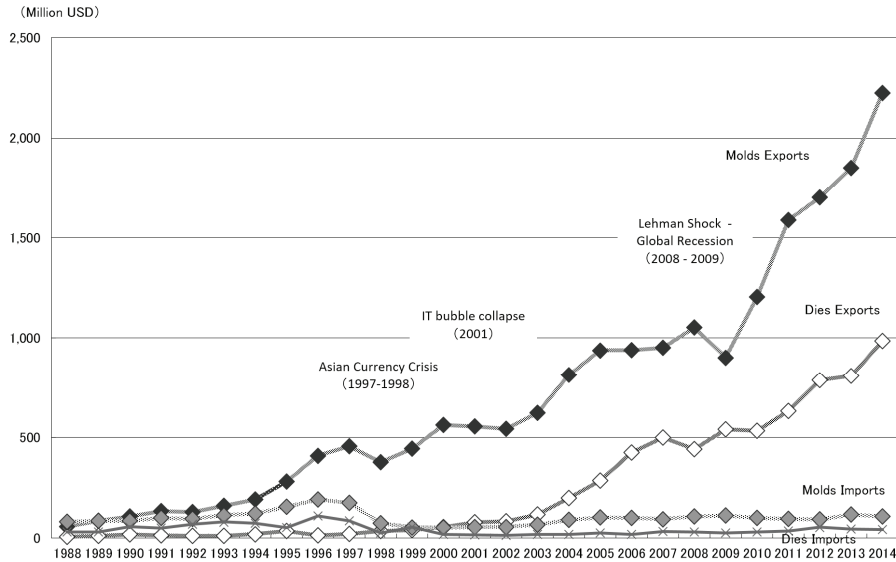


Figure 14. The Trade Situation for Korea’s Dies and Molds (1988~2014)

Data and notes are the same as for Fig. 2.

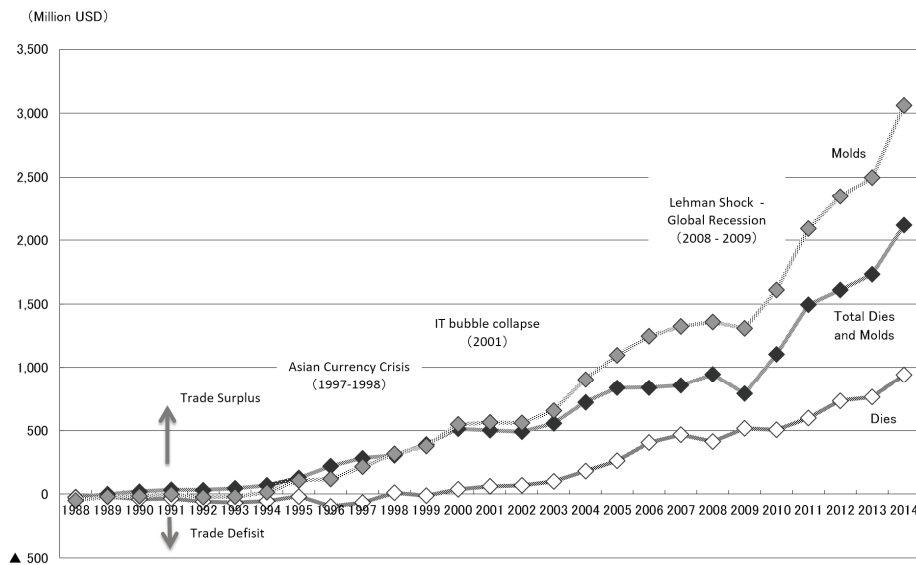


Figure 15. The Trade Surplus and Deficit in Korea’s Dies and Molds Trade (1988~2014)

Data and notes are the same as for Fig. 2.

(2) Korea’s International Competitiveness in Dies and Molds

Fig. 16 shows the trend in GCI values, which indicates Korea’s international competitiveness in dies and molds. Recently, GCI values for both dies and molds have remained around 0.9, which means the international competitiveness of Korean dies and molds is very strong, as can be seen in Fig. 16. Imports are extremely small compared to exports in both dies and molds. Looking back, the molds trade changed from a deficit to a surplus in 1990. The GCI values for molds rapidly increased in the 1990s and reached 0.8 in 2000.

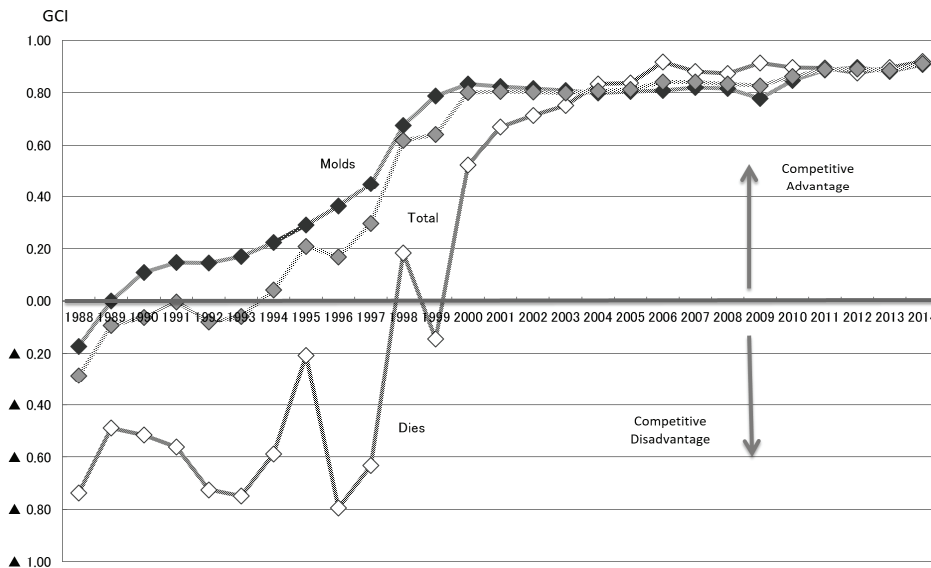


Figure 16. The International Competitiveness of Korea’s Dies and Molds (1988~2014)

Data and notes are the same as for Fig 2.

The GCI value for dies was negative until 1997. It turned positive in 2000 and reached 0.8 in 2004. The reason for this increase in international competitiveness is that Korea introduced technologies from Japan, established dies and molds departments in universities, engaged in bi-directional training between users and suppliers, accumulated new technologies, and introduced an export-oriented policy. Two other big factors were innovations in manufacturing and standardization (Baba 2005).

(3) Major Partners in Korea’s Dies and Molds Trade

① Molds

Previously, Korea was totally dependent upon Japanese molds. In 1990, 70% of molds imports were from Japan. This situation continued for many years until after the 2000s when Korea’s molds import partners were diversified. Korea imported special high-grade molds from Japan, and easy and cheap molds from China. In 2000, the share of imports from China was only 7%, but it reached 21 % in 2005. In 2009, it reached 38%, and China became the top import partner after Japan with 23%. Since then, molds imports from China have increased and pulled away from other countries. In 2014, the major molds trade partners and their shares were China 50%, Japan 22%, Vietnam 6%, Germany 4%, and the USA 4%.

Regarding molds exports, Japan used to be the top trading partner. The main reason for this was the outsourcing by Japanese molds manufacturers to reduce costs. Following expansion, Korea exported molds all over the world, including Asia, Europe and the USA. As China's industry developed, molds exports to China increased. In 2000, China became the top export partner with a share of 21%. Then Japan returned as the top export partner from 2011. In 2014, the major Korean molds export partners and their shares were Japan 18%, China 15%, Vietnam 8%, India 8% and Mexico 7%. One reason for the expansion in Korean molds is the development of Korean manufacturers, which are big users of molds. Recently, non-Korean molds users, are using Korean molds because of improvements in quality and active selling by the Korean molds manufacturers.

②Dies for Stamping

Korea was more dependent on dies (HS 820730) imported from Japan than for molds. In 1990, 90% of dies imports were from Japan. In 2005, it was 80% from Japan and in 2010 60%. However, after 2011, other countries were top: Germany in 2012, and China in 2013 and 2014. In 2014, the major partners for Korea's dies imports and their shares were China 25%, USA 20%, Japan 17%, Germany 9% and Thailand 7%. China also became the top import partner, as happened with molds.

Regarding Korea's dies exports, partners come from all over the world. Recently, China's share has become bigger. In 2014, the major Korean export partners and shares were China 23%, the USA 13%, India 12%, Japan 11%, and Mexico 5%. The export situation is almost the same as for molds.

3. An Analysis of International Competitiveness in Dies and Molds Worldwide

At the end of this paper, the author would like to analyze the international competitiveness of each major dies and molds manufacturing or using countries. To observe the trends in development, analysis was conducted for 1994 and 2014 in molds (HS8480) and dies (HS820730). The following countries were selected: among developed countries, Japan, German, Switzerland, USA, UK, Italy, France, Spain, Portugal, Sweden, Finland and Russia; among Asian NIEs, Korea and Singapore; for ASEAN, Thailand, Malaysia, Indonesia, the Philippines and Vietnam, and from other countries, China, India, Brazil, Argentina, Mexico, Turkey and South Africa. The trade data were extracted from the UN Comtrade data base. Although the author would like to have included Taiwan, it is impossible to select in a UN database. Some countries' data have not been extracted for 1994 because the data for these countries are not available.

3.1 Molds

Table 2 shows the sum of the trade value for molds, the trade surplus and deficit in the molds trade and the GCI value for each country in 1994 and 2014. In 1994, trade values for the USA, Japan and Germany were very large. In 1994, only Japan's international competitiveness was "very strong," based on the classification in Table 1. The only country classified as "strong" was Portugal. Countries in the "slightly strong" category were Italy, Switzerland, Germany and Korea. The USA had a high trade value, but it is classified as "slightly weak" because of its many imports.

By 2014, the situation had changed dramatically. Countries which had a large trade value in molds include China, the USA, Germany, Japan, Korea, Italy, and Mexico. The expansion of China, Korea and Mexico is especially remarkable. Countries that also greatly increased the trade values in their molds were Thailand, Portugal and France. The style of the molds trade changed from limited participation from a few countries to a multinational style in which many countries now participate.

In 2014, the only country classified as "very strong" was Korea, and the only country that was

classified as “strong” was Portugal. Countries classified as “slightly strong” were Italy, China, Japan, Switzerland, Singapore and Germany. The “Leaped” development of Korea and the “Globalization” development of Japan, as mentioned in Fig. 1, are remarkable. The international competitiveness of Chinese molds has quickly become stronger as has been mentioned, and this may change to “strong” or “very strong” in the near future. Supply and demand and the structure of international competitiveness have drastically changed in the 20 years between 1994 and 2014.

Table 2. Trade Values, Trade Surplus and Deficit, and International Competitiveness of Molds in Each Country in 1994 and 2014.

1994 Mold	Trade values (Million USD)	Trade surplus and deficit (Million USD)	International competitiveness (GCI)	2014 Mold	Trade values (Million USD)	Trade surplus and deficit (Million USD)	International competitiveness (GCI)
1 USA	2,323	▲879	▲0.38	1 China	5,800	2,533	0.44
2 Japan	1,516	1,259	0.83	2 USA	2,907	▲1,099	▲0.38
3 Germany	1,351	364	0.27	3 Germany	2,709	353	0.13
4 China	776	▲702	▲0.91	4 Japan	2,550	622	0.24
5 Italy	647	299	0.46	5 Rep. of Korea	2,331	2,118	0.91
6 France	481	26	0.05	6 Italy	2,171	1,036	0.48
7 Mexico	397	▲168	▲0.42	7 Mexico	1,751	▲1,154	▲0.66
8 Malaysia	373	▲241	▲0.64	8 Thailand	991	▲572	▲0.58
9 Singapore	334	▲41	▲0.12	9 Portugal	943	531	0.56
10 Rep. of Korea	313	70	0.22	10 France	862	▲34	▲0.04
11 Switzerland	274	94	0.34	11 Switzerland	701	121	0.17
12 United Kingdom	263	▲69	▲0.26	12 Malaysia	650	▲292	▲0.45
13 Thailand	232	▲189	▲0.82	13 India	642	▲435	▲0.68
14 Spain	204	7	0.03	14 Turkey	585	▲144	▲0.25
15 Portugal	183	136	0.74	15 Spain	577	▲33	▲0.06
16 Indonesia	98	▲91	▲0.93	16 Viet Nam	485	▲373	▲0.77
17 Brazil	97	▲42	▲0.43	17 Russian Federation	451	▲418	▲0.93
18 Turkey	85	▲67	▲0.79	18 Indonesia	426	▲358	▲0.84
19 Sweden	83	▲18	▲0.22	19 United Kingdom	358	▲182	▲0.51
20 India	47	▲39	▲0.82	20 Brazil	307	▲233	▲0.76
21 Argentina	44	▲36	▲0.82	21 Singapore	272	40	0.15
22 Finland	21	▲5	▲0.25	22 Finland	111	▲1	▲0.01
				23 Argentina	99	▲90	▲0.91
				24 South Africa	88	▲61	▲0.70
				25 Sweden	82	▲45	▲0.55
				26 Philippines	55	▲35	▲0.63

Data are the same as for Fig. 2.

3.2 Dies

Table 3 shows the total trade value for dies, the trade surplus and deficit in the dies trade and the GCI value for dies in each country in 1994 and 2014. In 1994, the trade value of Japan, the USA and Germany were extremely high, followed by Spain and Mexico.

In 1994, the GCI value of Japan was 0.94, and the international competitiveness of Japanese dies was “very strong”. There were no countries classified as “strong” in 1994. Countries classified as “slightly strong” were Spain, Germany and Switzerland. The USA, which had a high trade value in dies, is classified as “weak” because of its many imports, which is similar to the situation with molds.

In 2014, countries which had a high trade value in dies included Germany, China, the USA, Japan and Korea, followed by Mexico, Spain and Italy. In 2014, the “very strong” countries were Korea and Japan. Again the Korean “leaped” model and Japan’s “holding domestic production” model can be seen. The one country classified as “strong” is Italy, while the “slightly strong” countries are Spain, Germany and Turkey. China, which observed high growth in molds, is classified as “slightly weak.” The USA changed from “weak” in 1994 to “slightly weak” in 2014 because of an increase in its exports. Supply and demand and the structure of international competitiveness changed in the 20 years between 1994 and 2014, like that for molds. However, the situation regarding highly internationally competitive countries is slightly different from that of molds because of production difficulties. Generally speaking, molds tend to be relatively easy to design and produce because innovation and standardization proceed with changes in the structure of international competitiveness and global procurement, and dies may follow the same tendency.

Table 3. Trade Values, the Trade Surplus and Deficit, and International Competitiveness in Dies for Each Country in 1994 and 2014.

1994 Die	Trade values (Million USD)	Trade surplus and deficit (Million USD)	International competitiveness (GCI)	2014 Die	Trade values (Million USD)	Trade surplus and deficit (Million USD)	International competitiveness (GCI)
1 Japan	740	692	0.94	1 Germany	1,646	490	0.30
2 USA	532	▲322	▲0.61	2 China	1,594	▲201	▲0.13
3 Germany	492	137	0.28	3 USA	1,422	▲509	▲0.36
4 Spain	205	74	0.36	4 Japan	1,382	1,077	0.78
5 Mexico	102	▲90	▲0.88	5 Rep. of Korea	983	937	0.95
6 Switzerland	70	19	0.28	6 Mexico	585	▲509	▲0.87
7 Brazil	62	▲61	▲0.97	7 Spain	551	268	0.49
8 Rep. of Korea	59	▲34	▲0.58	8 Italy	439	285	0.65
9 Singapore	8	▲4	▲0.43	9 Russian Federation	223	▲212	▲0.95
10 Indonesia	8	▲7	▲0.95	10 United Kingdom	221	▲28	▲0.13
11 Portugal	7	▲3	▲0.45	11 Brazil	213	▲167	▲0.78
12 Thailand	7	▲6	▲0.83	12 Switzerland	180	17	0.09
13 Malaysia	6	▲5	▲0.85	13 India	176	▲139	▲0.79
14 Finland	3	▲3	▲0.82	14 France	141	▲37	▲0.26
15 India	1	▲0	▲0.19	15 Turkey	89	14	0.16
16 Turkey	1	▲1	▲0.95	16 Thailand	82	▲51	▲0.62
				17 Sweden	73	▲26	▲0.36
				18 Indonesia	48	▲43	▲0.90
				19 Malaysia	45	▲18	▲0.40
				20 Viet Nam	40	▲16	▲0.40
				21 Portugal	35	▲5	▲0.15
				22 Argentina	30	▲21	▲0.70
				23 Singapore	24	▲3	▲0.14
				24 South Africa	11	▲10	▲0.85
				25 Finland	10	▲3	▲0.30
				26 Philippines	1	▲0	▲0.21

Data are the same as for Fig. 2.

4. Conclusion

In this paper, the author analyzed structural changes in supply demand and international competitiveness in dies and molds in different countries after the 1990s, when big changes occurred. Dies and molds are essential tools for mass production-type machine industries, such as the automobile and ICT industries, in the areas of design and production (Baba 2005). There is another less common style of using hundreds of the same machine tools without dies or molds, like in the manufacture of i-phone covers in China. From the viewpoint of production speed or production costs, using dies and molds in mass production may continue for a while.

In this paper, the author analyzed in detail the cases of India, Brazil, Thailand, China and Korea. In India, although they have accumulated basic skills and technology for making dies and molds in their history of industrialization, they have not adapted to the expansion in demand either qualitatively or quantitatively. At this moment, they rely heavily on high-grade dies and molds for imports. The Indian dies and molds industry has developed remarkably in recent years, according to the field survey. However, this survey also revealed that the trade deficit in both dies and molds has been increasing and India's dependence on imports has become stronger. The GCI of both dies and molds has remained low, which shows weak international competitiveness. The import procurement of dies and molds used to be mainly from Japan. Recently, Korea and China have overtaken imports from Japan. In 2014, in molds imports, the top share was held by China and the second by Korea far exceeding Japan. In dies imports the top share of Korea at 57% is remarkable.

In Brazil, the skills and technology for making high-grade dies and molds were brought into the country by European immigrants and advanced automobile manufacturers. The Brazilian engineers whom the author met were sincere and enthusiastic about manufacturing. Skills and technologies were accumulated in the factories, and training for making dies and molds flourished. However, recently, Brazil's international competitiveness in both dies and molds has fallen dramatically. Added to this, international dies and molds procurement from the mother country of foreign affiliated dies and molds users, such as Korea, caused a rapid increase in dies and molds imports in recent years. Around half the total share of molds imports is occupied by only China and Korea. Regarding dies imports, although the dependence on Japan dies is remarkable at the moment, the rise of China and Korea is also noteworthy.

Thailand has a long history of industrialization compared to other ASEAN countries, and industrial clusters have formed, for instance, in Bangkok and its environs. The author received the impression from the field survey that companies can procure high-grade dies and molds from the domestic market and they export dies and molds to many countries. However, according to this trade analysis, an increase in the deficit in dies and molds is apparent. The result of the analysis shows that the dependence on imports is remarkable in both dies and molds. Regarding Thailand's international competitiveness in dies and molds, although there were signs that it may improve, it is still weak. Regarding trade partners, Japan is remarkable in both dies and molds because many Japanese manufacturers have moved to Thailand. On the other hand, a multi-polar trend in imports has started, especially in molds. Imports from China, Korea, Taiwan, Singapore and the USA have increased. The rising presence of China and Korea is of note.

China achieved rapid economic growth after the 1990s as a result of industrialization. Following the development of industrialization, dies and molds imports have increased. China's huge market and economic growth have pushed dies and molds manufacturers from many countries to go to or assist with technology in China. These countries include Japan, countries in Europe, the USA, Taiwan, Hong Kong and Singapore. The dies and molds industry in China has grown rapidly. After the middle of the 2000s, molds exports increased rapidly. The international competitiveness in

molds changed from being comparatively disadvantageous to being comparatively advantageous in the middle of the 2000s. The GCI of dies continued to be low until the latter half of the 2000s. After 2010, the GCI value of dies started to increase and in 2014 it almost changed from being disadvantageous to being advantageous. China's international competitiveness in dies may also change to being comparatively advantageous in the near future. Regarding China's dies and molds imports, Japan used to be the most important country. In 2013, Korea moved ahead of Japan to have the top share in China's molds imports. Korea was top in dies in 2014. Regarding dies and molds exports, China now exports all over the world, and China's presence in many countries has increased remarkably.

Korea used to rely heavily on high-grade dies and molds imports from Japan. In the 1990s, Korea rapidly caught up and became a country that could make all grades of dies and molds domestically. The international competitiveness of its molds rapidly improved in the early half of the 1990s, and that of dies rapidly grew in the early half of the 2000s. Today, Korea retains high international competitiveness in both dies and molds. The presence of Korean dies and molds in all countries is quite high these days.

Previously, Japan was incomparably strong in the international competitiveness of its dies and molds. After the 1990s, the Asian dies and molds industry grew rapidly, especially in Korea and China. At first, the change was seen in molds, then the change in dies followed. The structure of the Global Value Chain of dies and molds has changed from an overconcentration to multi-polarity. The dies and molds industry has plunged into an age of global competition.

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