

# Invitation to the Study of Dies and Molds

BABA, Toshiyuki / 馬場, 敏幸

---

(出版者 / Publisher)

法政大学比較経済研究所 / Institute of Comparative Economic Studies, Hosei University

(雑誌名 / Journal or Publication Title)

Journal of International Economic Studies

(巻 / Volume)

31

(開始ページ / Start Page)

1

(終了ページ / End Page)

11

(発行年 / Year)

2017-03

(URL)

<https://doi.org/10.15002/00013902>

# Invitation to the Study of Dies and Molds

**Toshiyuki Baba**

*Faculty of Economics, Hosei University*

## Abstract

Dies and molds are the apparatus for realizing dreams and ideas. They are metallic tools that produce many copies of the same product precisely and speedily. Materials that can be made in this way include plastics, metals, glass fibers, glasses, rubbers, polystyrene foams and foods. In this paper, for the better understanding of dies and molds, the author describes several features of dies and molds, such as their basic mechanism, their classification, their merits, the contribution of high-quality dies and molds, the stages of development of the dies and molds industry, international competitiveness in the industry, and the development model for dies and molds.

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

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

## 1. What are Dies and Molds ? How Important are they to Mass Production?

### 1.1 Dies and Molds are the Apparatus for realizing Dreams and Ideas

What are dies and molds? They are metallic tools to produce many copies of the same product precisely and speedily. Materials that can be produced in this way include plastics, metals, glass fibers, glasses, rubbers, polystyrene foams and foods.

Automobiles or electric products are manufactured to be assembled from many different components and parts, most of which are made through the use of dies and molds. Many dies and molds are needed to make any one mass produced commodity. For example, one simple electronic appliance needs hundreds of dies and molds. For one automobile, we need several tens of thousands of dies and molds.

Dies and molds contribute not only to qualities such as appearance, performance and accuracy, but also to improvements in productivity and stability. For the automobile and ICT industries, which many developing countries would like to promote and expand, dies and molds are essential. In Asian developing countries, as industries develop, demand for dies and molds increases. In the past, these countries could not supply the dies and molds they needed in their countries and they depended upon imports from advanced countries such as Japan, Europe or the USA.

For advanced countries or emerging countries which want to improve their products and add value, thus avoiding the "Trap of Middle-Income Countries," R&D is important. Dies and molds play another important role. Regarding the quality of dies and molds, one needs to bear in mind the following. How can one make the designed shapes precisely with the materials one desires? Is it possible to stabilize mass production? Is it possible to attain a desirable level of performance? These

issues are solved by developing methods to process new materials, the unification of plural processes with many components and parts, substantial weight reductions, improved resistance to corrosion, better strength and productivity, methods to cut and shape difficult working materials, the manufacture of complex shapes, integral molding using more than two types of materials, cost reductions, and so on. This can all be achieved through the development of suitable dies and molds. Some detailed examples are described later in sections 1.4 and 1.5.

No matter whether the R&D is an “integral type” or a “module type”, dies and molds are essential tools for realizing the dream of making a design for a competitive commodity. The development stages of industrialization in a country are deeply connected to the ability to develop and make suitable dies and molds.

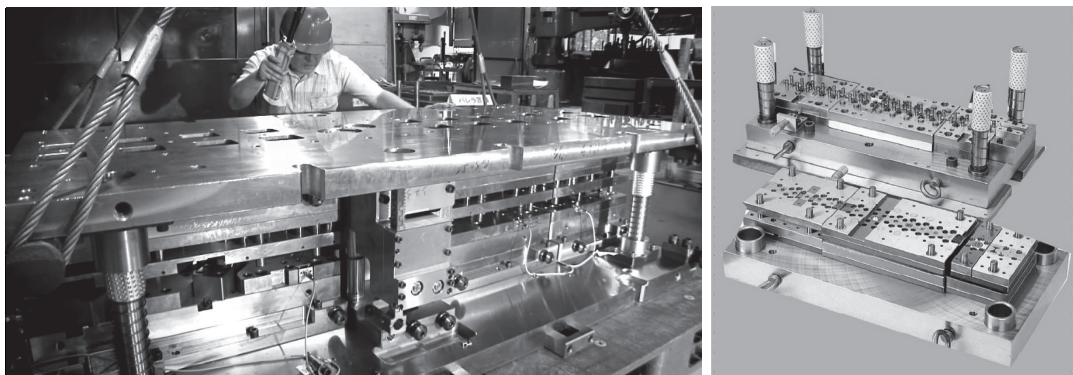
### ***1.2 The Basic Mechanism of Dies and Molds***

In many cases, dies and molds consists of two faces: a male face and a female face (Photo 1). Although these faces open in a variety of ways, such as top and bottom, right and left, or front and end, the basic mechanism is the same. Raw materials are sandwiched between the male face and the female face, then shaped as designed. Basically a female face is fixed while a male face can be opened and makes space. Raw materials are put into this space. As the male face is closed, the shape is transferred from the dies and molds to the material. Although in many cases the form of the dies and molds is a quadrangular box, there are various forms such as columns, polyhedrons, naked single dies/molds and so on.

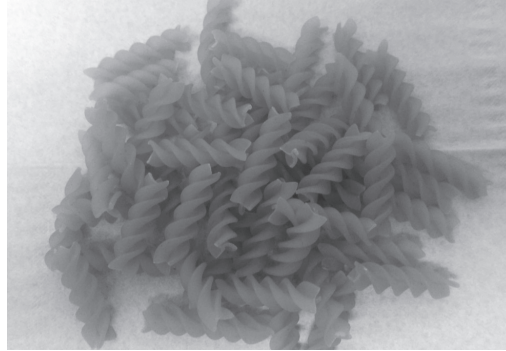
In the case of metal stamping or metal pressing, the male face is called a punch, and the female is called a die. In plastic injection molding or metal die-casting, a female face is called a cavity which is concave. While the male face is called a core and is convex. In blow molding, although the structure consists of two faces, both faces are concave. The gas is sent into the raw material and the swelled material is pressed into the mold, forming the product.

In many cases, molds used for making plastic trays have one face. Heated plastic sheets are on molds, then they are vacuumed and pressed onto the face of the mold. In many cases, dies used for making such as hoses, metal wires, synthetic fibers or pastas, have only one face. Raw materials are sent under high pressure onto dies which have holes, then the shapes of the holes are transferred to the raw material (Photo 2). This is like mayonnaise being shaped by going through the hole of a mayonnaise container.

**Photo 1. A progressive die for metal stamping**



Ogaki Seiko Co., Ltd.

**Photo 2. Fusilli is made with a naked die.**

Author

### ***1.3 The Merits of Using Dies and Molds***

We can produce high precision parts and components in large quantities without using dies and molds. There are a variety of manufacturing methods, such as processing with a CNC machining center, laser beam machining or rapid prototyping (a 3D printer). So why are dies and molds used for mass production in many cases? The reasons for this are that production using dies and molds is usually superior to other methods, taking into account issues like speed, accuracy and unit costs.

The 3D printer method is gaining a lot of attention these days. Let us compare the production of a car part using these two methods: a die/mold and a 3D printer. With regard to speed, although it takes a few hours to a few days with a 3D printer, it takes only milliseconds to a few minutes with a die/mold. On the cost of raw materials, using a 3D printer costs from 40 to 400 USD/kg. With a die/mold, high-tension steel is around 0.7 UDS/Kg, ultra-high-tension steel is around 1.1 UDS/Kg, normal engineering plastic beads are 8.3 USD/kg, and high grade engineering plastic beads are 42 USD/kg. The strength and accuracy of products made using a 3D printer are inferior compared to when one uses a die/mold, because products made with a 3D printer are laminated structures. Although one can use many raw materials in the same process with a die/mold, this is impossible when using a 3D printer. As mentioned above, a die/mold method has many advantages compared to a 3D-printer method at present.

### ***1.4 How Efficient are High-quality Dies?***

The author conducted some thought experiments with professional engineers from several manufacturing companies about how the quality of a die affects accuracy or productivity (Baba 2010). Table 1 shows the results of the first experiment. In this experiment, we assumed the production of a precise metal part for an electronic product, with a size of a few cm by a few cm (such as on the right of Photo 3). If a skillful craftsman made this by hand, we estimated that he could make it within  $\pm 500\mu\text{m}$  preciseness in 1,800 seconds (30 minutes).

Then we considered a method using several tandem dies in the form of stamping machines, which are sometimes seen in developing countries. We thought that they could make this item within  $\pm 50\mu\text{m}$  of precision in 7 seconds. The thickness of one cat's hair is around  $50\mu\text{m}$ . It would only take 7 seconds to make this precise part. The processing accuracy or productivity involved in using the die is obvious.

Finally, a brand new advanced die made in Japan took only 0.075 seconds to make one part with  $\pm 3\mu\text{m}$  preciseness using only one set of this progressive die whose shape is similar, as can be

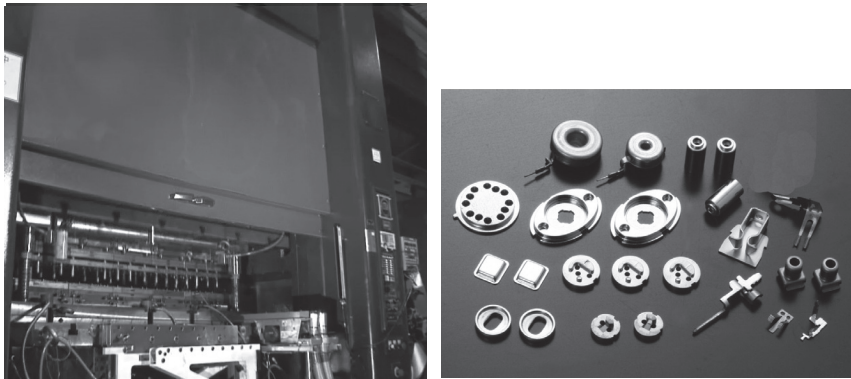
seen in photo 1. Moreover, it is possible to include cold forging processes in this die, which changes the thickness of a metal anywhere and with high accuracy. This makes it possible to obtain one part from composite parts, which can reduce a part's weight, size, and the time it takes to manufacture a piece. This affects the quality, production cost and productivity of the final product. There is also another merit in using this progressive die. The raw material of the progressive die method is a rolled metal sheet, which is set on an automatic feeder. It is possible to operate this automatically at night without any human by adjusting the feeding speed. This means it is possible to have automatic operation 24 hours a day, except when mounting the rolled metal sheet or changing the die. This can not only increase productivity but also reduce human error caused by fatigue or carelessness.

**Table 1. Results of Thought Experiment on Dies**

	Machining time ratio (real number)	Takt time ratio (real number)	Precision	Minimum workers required	Production quantity at one time
High quality progressive die (two rows in one die)	1 time (4.2 seconds)	1/2 time (0.075 seconds)	$\pm 3 \mu\text{m}$	0.2–0.3 persons	2 units 24 hours operation possible
High quality progressive die (one row in one die)	1 time (4.2 seconds)	1 time (0.15 seconds)	$\pm 3 \mu\text{m}$	0.2–0.3 persons	1 unit 24 hours operation possible
Tandem dies	22 times (91 seconds)	47 times (7 seconds)	$\pm 50 \mu\text{m}$	8 persons	1 unit
Skillful craftsman	429 times (1,800 seconds)	12,000 times (1,800 seconds)	$\pm 500 \mu\text{m}$	1 person	1 unit

Author

**Photo 3. The Progressive Die Set onto a Stamping Machine (left)  
High Precision Metal Parts produced through Progressive Dies (right)**



Ogaki Seiko Co., Ltd.

### 1.5 How Efficient are High-quality Molds?

Table 2 shows the result of the second experiment. In this experiment, we assumed the production of a precision plastic part for an automobile with a size of a few dozen centimeters by a few dozen centimeters. In this case, we considered the replacement of a previous auto part with a new auto part. The new part is the same shape but the raw material differs from the previous one, which was made by assembling plural metal sub-parts that were produced by shaving in dedicated machine tools. The

new part is a single structure of engineering plastic using an injection molding method.

It took 1,800 seconds (30 minutes) to make one part using the previous method. By using the mold, this was reduced to only 15 seconds. The unit cost of the raw material is reduced by one quarter, and the resistance to corrosion is much improved. Using the new method, it becomes possible to operate automatically for 24 hours without needing people at night. The previous method costs millions of USD, including several dedicated machine tools that require new investment. The investment to start the new production costs 140 thousand USD, including a plastic injection molding machine and a mold. Thus it becomes possible to drastically reduce investment costs. The investment cost should be added onto the unit price as part of the depreciation cost. There are many merits to changing the production method to using a mold, such as reducing the cost of raw materials, reducing labor costs due to 24-hour automatic operation, reducing investment costs, improving production speed and quality, and so on.

**Table 2. Results of Thought Experiment on the Mold**

	Takt time ratio (real number)	Weight of part	Cost of raw material	Number of manufacturing processes	Production units at one time	New investment (USD)	Others
The new method using a mold	1 (15 seconds)	1	1	1	4	140	-Improved resistance to corrosion -24-hour automatic operation
The previous method using machine tools	120 times (1,800 seconds)	3-6 times	3-4 times	7	1	Several millions	

Author

According to these two thought experiments, we can find out how many advantages exist by using dies and molds, such as the high speed of production, and stable production or high-precision production. This high speed automatic operation has drastically reduced the production unit cost. Although the ratio of this reduction differs from case to case, it is sometimes reduced by more than 90% from the previous unit production cost if the production method is greatly changed. It is very important to reduce the unit price of one auto part from one USD to a few cents. In the automobile industry, there is a struggle to realize reduced costs every day in order to enhance competitiveness. It is quite difficult to reduce production costs from a level that has already achieved high productivity improvements and rationalization. It is often said that it is like squeezing a dry swabbing cloth. In this way, improving the dies and molds process has contributed to manufacturing all over the world.

## 2. The Classification of Dies and Molds

### 2.1 *The Census of Manufacturers and Machinery Statistics in Japan*

There are many kinds of dies and molds. In the case of Japan, important statistical sources are “The Census of Manufacturers” and “Machinery Statistics.” Both sets of statistics can be accessed through the internet.

The Census of Manufacturers is a complete annual survey. The data are gathered from all manufacturing sites in Japan, except for public manufacturing sites. The data includes information

such as the number of manufacturing sites, the number of workers, the value of the shipments, and the value of raw materials. This census was started in 1909 as statistics on company products. The Census of Manufacturers is conducted on all establishments in years ending with a 0, 3, 5 and 8 on the Western calendar year from 1981 to 2009. For other years, the census covers establishments with four or more employees (Japanese METI).

Although the Machinery Statistics data are gathered monthly, it is a sample survey. In the case of the dies and molds industry, those manufacturing sites that employ more than 30 people are covered. This survey started in 1948 when the General Headquarters (GHQ) commissioned it so as to grasp the conditions of production in order to control the supply and demand of manufactured goods.

The classification of dies and molds in the Census of Manufacturers is “for metals” such as those for metal stamping, forging, casting, die-casting, other uses, and parts or components, and “for non-metals” such as those for plastic, rubber, glass, others, and parts or components. Classification in the Machinery Statistics is for metal stamping, plastics, die-casting, forging, casting, powder metallurgy, rubber and glass.

For many of these dies and molds, the dies for metal stamping and the molds for plastic injection are the most common worldwide. According to the machine statistics of 2013, the share of dies for metal stamping was 39% and the share of molds for plastic injection was 34% in Japan. The share of only these two types amounted to 73% of total production in Japan. According to the Census of Manufacturers, the share of these types of dies/molds is similar.

## ***2.2 Classification in Trade Statistics***

Useful sources of data in trade analysis are UN Comtrade and the Trade Statistics of each country. It is possible to access both through the internet in the case of Japan. In order to investigate the trade situation in Japan, it is convenient to search the web site of the Finance Ministry of Japan ([http://www.customs.go.jp/toukei/info/index\\_e.htm](http://www.customs.go.jp/toukei/info/index_e.htm)). It is possible to find annual data from 1988 and monthly data from 1998 there. When we want to search for earlier data, we should look at the book “Trade Statistics of Japan Ministry of Finance”.

In order to research international trade conditions, it is convenient to search the Comtrade data base (<http://comtrade.un.org/>). There, we can find both time series data and cross-section data for almost all countries for years from around 1990.

The trade total for dies is the sum of HS820720 and HS 820730. That for molds is HS8480. HS is an abbreviation of the Harmonized Commodity Description and Coding System where a code indicates each commodity. The explanation of each HS code is as follows (<https://www.gov.uk/trade-tariff/>):

-HS8207: Interchangeable tools for hand tools, whether or not power-operated, or for machine tools (for example, for pressing, stamping, punching, tapping, threading, drilling, boring, broaching, milling, turning or screw driving), including dies for drawing or extruding metal, and rock-drilling or earth-boring tools.

-HS820720: Dies for drawing or extruding metal

-HS820730: Tools for pressing, stamping or punching

-HS8480: Molding boxes for metal foundry; mold bases; molding patterns; molds for metal (other

than ingot molds), metal carbides, glass, mineral materials, rubber or plastics

### **3. Development Stages and an Analysis of the International Competitiveness of Dies and Molds.**

#### ***3.1 Development Stages of the Precision Dies and Molds Industry***

Table 3 shows the development stages of the precision dies and molds industry by segment. This is based on interviews with dies and molds users with high procurement standards. Although there are many quality grades in the dies and molds market, the author set the standard quality level to match the needs of global level manufacturers such as those that exist in the automobile or ICT industries. The author uses “Global level manufacturers” for a mixture of foreign-affiliated global manufacturers which produce commodities of good quality and local manufacturers which can produce commodities of a competitive quality to them if such exist in a country. Though their needs are quite high, there is a great deal of competition in this global market. The author defined this high level as the “precision segment.” On the other hand, there is a segment in the dies and molds market where players do not strictly need the same level of accuracy. The author has defined this as the “general segment”.

As Table 3 shows, the first stage, which is the lowest level of development, has been named the “period of dependence on dies and molds imports.” This period assumes a situation where global level players cannot procure a suitable quality of dies and molds domestically in a country aiming at economic development through industrialization. The dies and molds industry either does not exist locally or dies and molds are of a quality that comes nowhere near the procurement standards of global level players. At this stage, they depend entirely on dies and molds imports from other countries.

The second stage is named the “period of dependence on local foreign-affiliated companies.” This is the stage where the procurement of dies and molds by global level players becomes possible as a result of the advance of foreign-affiliated companies or technical tie-ups. Even if local companies produce dies and molds, it is assumed that at this stage they have not yet reached the level where they meet the procurement standards of global level players. At this stage, they depend on local foreign-affiliated dies and molds suppliers or they should import dies and molds from other countries or they should make their dies and molds in-house.

The third stage is the “period of segmentation.” At this stage, it is assumed that local dies and molds suppliers that have reached a high standard in production and meet the procurement standards of global level players are emerging and their number is increasing. Global level players are reaching this stage where they can procure a large number of their dies and molds locally. At this stage, in many cases, the procurement of global level players is divided between imports from overseas, procurement from local foreign dies and molds suppliers, manufacturing in-house, and procurement from locally owned suppliers. For example, medium- to high-quality dies and molds are procured through imports from abroad or local foreign-affiliated suppliers, or they may be produced in-house. On the other hand, low- to medium-quality dies and molds are procured from locally-owned dies and molds suppliers.

The fourth stage is the “period of emergence of locally-owned suppliers of high-quality dies and molds.” At this stage, the development of the local dies and molds industry is evident, and superior local dies and molds makers are emerging. Although the level of some superior local dies and molds makers may sometimes nearly reach the technological level of developed countries, the number of such producers is small.

The fifth stage is the “period of maturity.” At this stage, locally-owned dies and molds



suppliers have grown to where they hold an influential position in the market. At this stage, global level players no longer need to depend on imports and foreign-affiliated suppliers. Irrespective of whether their dies and molds are sourced from locally-owned or foreign-affiliated suppliers or from imports, the dies and molds market has an overall competitive environment in dies and molds of all qualities from low- to high-quality.

The final and sixth stage is the “period of globalization.” At this stage, imports of dies and molds increase again, and exports decrease. This is a result of the globalization of production, R&D and procurement sites among dies and molds users and suppliers, or increased outsourcing of dies and molds due to the need to reduce costs.

Table 4 shows the results of field surveys in each country. Although until the 1990s Japan was the outstanding dies and molds country in Asia, dies and molds industries in Asian countries have improved recently.

**Table 3. Standards for Classifying the Developmental Stages of Dies and Molds**

Stage 1: Period of dependence on dies and molds imports	<ul style="list-style-type: none"> <li>● Global level players are unable to procure dies and molds locally</li> <li>● They rely on imports from abroad or produce in-house</li> <li>● Even if there are locally-owned companies that produce molds and dies, their products do not meet the standards required by global level players.</li> </ul>
Stage 2: Period of dependence on local foreign-affiliated companies	<ul style="list-style-type: none"> <li>● Global level players are able to procure molds and dies locally due to the entry of foreign companies as well as capital and technical tie-ups</li> <li>● The technological level of locally-owned dies and molds companies may gradually improve, global level players may start to procure from them and/or foster their technological level.</li> </ul>
Stage 3: Period of segmentation	<ul style="list-style-type: none"> <li>● Global level players can procure many of their dies and molds locally.</li> <li>● Dies and molds suppliers consist of a combination of overseas suppliers, local foreign-owned dies and molds suppliers, and locally-owned dies and molds suppliers.</li> <li>● Procurement of medium- to high-quality dies and molds is from overseas countries, local foreign-owned dies and molds suppliers or are produced in-house by global level players.</li> <li>● Low- to medium-quality dies and molds are available from locally-owned dies and molds suppliers</li> </ul>
Stage 4: Period of emergence of locally-owned suppliers of high-quality dies and molds	<ul style="list-style-type: none"> <li>● Certain number of local companies can produce medium- to high-quality dies and molds.</li> <li>● Development of the local dies and molds industry is becoming evident, and superior local dies and molds makers are emerging.</li> <li>● Although the level of some superior local dies and molds makers may sometimes nearly reach the technological level of developed countries, the number of these producers is small.</li> <li>● In many cases, there will still be a technological difference between many locally owned dies and molds suppliers and foreign-affiliated suppliers.</li> </ul>
Stage 5: Period of maturity	<ul style="list-style-type: none"> <li>● Dies and molds of all types from low to high quality are in a general competitive environment in that country’s dies and molds market irrespective of whether the dies and molds are sourced from locally-owned dies and molds suppliers, local foreign-affiliated dies and molds suppliers, or imports</li> <li>● Locally-owned dies and molds suppliers have reached the stage where they hold an influential position in the market.</li> <li>● Global level players no longer need to depend on imports and foreign-affiliated suppliers.</li> </ul>
Stage 6: Period of globalization	<ul style="list-style-type: none"> <li>● Imports of dies and molds increase again, and exports decrease.</li> <li>● This is caused by the globalization of production, R&amp;D and procurement sites among dies and molds users and suppliers, or increased outsourcing of dies and molds due to the need to reduce costs.</li> </ul>

Author

**Table 4. Development Stages of Each Country**

	Molds	Dies
Vietnam	Stage 3	Stage 2
Indonesia	Stage 3	Stage 2
India	Stage 3	Stage 3
Brazil	Stage 3	Stage 3
Thailand	Stage 4	Stage 4
China	Stage 4	Stage 4
Korea	Stage 5	Stage 5
Japan	Stage 6	Stage 5
USA	Stage 6	Stage 6

Author

### 3.2 An Analysis of the International Competitiveness of Dies and Molds

Trade statistics for dies and molds are used to analyze topics such as trends in international competitiveness, the structure of the overseas dependence of a country, interdependence in the global supply chain, or changes in the supply and demand structure due to developments in the GVC (Global Value Chain).

In order to analyze the international competitiveness of dies and molds, the Global Competitiveness Index (GCI) is useful. The GCI is the same as the Trade Specialization Coefficient. The term “GCI” is used because it is thought to be better suited to expressing international competitiveness (Baba, 2015). The formula for the 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 5. The trade statistics are extracted from the data base of UN Comtrade.

**Table 5. International Competitiveness of each GCI Value**

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

### 3.3 The Development Model for Dies and Molds

The development model for international competitiveness in dies and molds suggested by the author is shown in Fig. 1. The horizontal axis is time while the vertical axis is the international competitiveness of dies and molds, which can be weak or strong. This is divided into two parts: one for emerging countries and the other for developed countries.

#### (1) The Model of Emerging Countries

The left side of the model represents emerging countries. In this part of the model, two paths for the international competitiveness for dies and molds are suggested as representing how dies and molds have been developing in emerging countries. At the first stage of industrialization, the international competitiveness of dies and molds is considered to be quite weak in developing countries, as was seen in Table 3. Then, gradually, international competitiveness increases. When this goes smoothly and the trend in direction of the competitiveness of dies and molds improves, this can be called the “Leaped Development Model” or the “Fortitude” type. In this type, the correlation between time and the competitiveness of dies and molds is positive. The more industrialization progresses, the more the demand for high-quality dies and molds increases. When suppliers of dies and molds develop alongside progress in industrialization, they can supply dies and molds to domestic users or foreign users. Then, as time goes by, the GCI value rises.

The other type can be called the “Development Dilemma Model” or the “Paper Tiger” type. In this type, as industrialization improves, the competitiveness of dies and molds declines. The correlation between time and the competitiveness of dies and molds is negative. If progress of the dies and molds industry is not good, users need to import dies and molds for their manufacturing. In order to produce industrial products to global standards, they have to import dies and molds of high quality. In this type, the more industrialization improves, the more the competitiveness of local dies and molds weakens. The Paper Tiger appears strong on the outside, but inside there is no muscle or internal organs, only air.

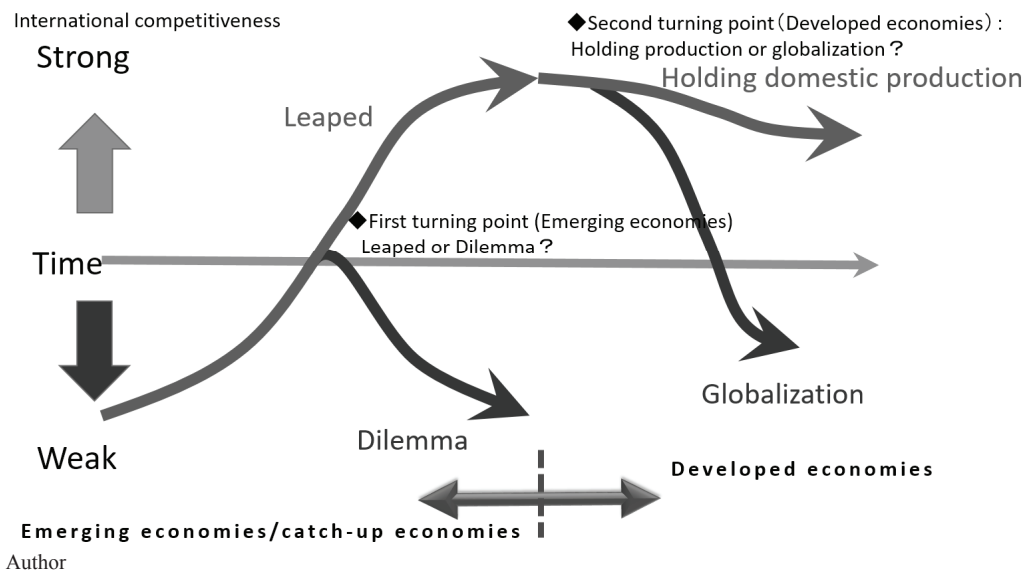


Figure 1. The Development Model for Dies and Molds

## (2) The Model of Developed Countries

The right side of the model in Fig. 1 represents developed countries. In this part of the model, two paths of international competitiveness for dies and molds are suggested. One is the “Holding Domestic Production Model”, the other is the “Globalization Model.” In the former, although there is a gradual increase in imports and a reduction in exports as a result of cost advantages or globalization, the domestic production of dies and molds remains at a certain volume because they can maintain production and supply domestic and overseas users, thus the international competitiveness of dies and molds stays strong.

In the globalization model, the international competitiveness in dies and molds weakens. It is sometimes observed that manufacturers in developed countries shift their production overseas because of global strategies based on cost advantages, the desire to sell their products to foreign markets, or political demands. It is also observed that dies and molds users and suppliers increase their imports of dies and molds from emerging countries for cost reasons. Then the domestic dies and molds market and the dies and molds industry gradually shrink. As a result, exports of dies and molds fall and imports increase, which makes the international competitiveness of a nation’s dies and molds industry weaker.

## 4. Finally

In this paper, the author describes dies and molds, the merits of their use and their contribution to various industries, and some methods to analyze dies and molds. This paper introduces this special issue of dies and molds research to help improve understanding about the international situation of dies and molds.

Acknowledgement: This research was supported by JSPS KAKENHI 26301024

## References

- Baba T. (2015) “Changes in International Competition regarding Auto-parts in China, Korea, and Japan”, *Journal of International Economic Studies*, 2016 No.30, 27-40 (Japanese)
- Baba T. (2010) “The Role and Contribution of Supporting Industries to Industrial Competitiveness”, *The Journal of Science Policy and Research Management*, Vol.24 No.4 2009 pp.302-308
- Census of Manufacture (Japanese METI) : <http://www.meti.go.jp/english/statistics/tyo/kougyo/index.html>
- Machinery Statistics (Japanese METI) : <http://www.meti.go.jp/english/statistics/tyo/kikai/>
- The Trade Statistics of Japan (Japanese MOF) : [http://www.customs.go.jp/toukei/info/index\\_e.htm](http://www.customs.go.jp/toukei/info/index_e.htm)
- UN comtrade: <http://comtrade.un.org/>
- UK Trade Tariff: <https://www.gov.uk/trade-tariff/>