明治大学 経済教育研究センター
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EXAMPLE OF TEXTBOOK OF ECONOMIC THEORY ON FLOWER

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Ⅰ. The Flower Economy of Japan 1: Income elasticity and price elasticity of flowering plants in Japan (see Note 1)

Foreword

In this chapter, we will study the income elasticity of demand (hereinafter referred to as income elasticity) and the price elasticity of demand (hereinafter referred to as price elasticity) using Japanese flowering plants as an example. For goods traded in the economy, demand changes as the conditions therein change. For example, if consumer incomes change, demand for orchids changes accordingly. In addition, if the price of orchids changes, concomitant demand for them changes, too.

However, the way this change is borne out likely differs between orchids and begonias. Orchids are used for both ornamental purposes and for festivals and celebratory occasions, and as gifts. Begonias, on the other hand, are strictly ornamental. In this way, flowers may be used differently by the end consumer.

Rather than illustrating these differences by way of a questionnaire, we utilize economic data to clarify them. Income elasticity and price elasticity are generally used to elucidate the above.

In Japan, there are certain types of flowering plants that are considered mainstream. Looking at the volume of potted plant shipments (figure below), orchids, cyclamen, chrysanthemum, primula, begonia, and dendrobium are the chief types of flowers being trafficked on the market. As consumers, we purchase these for different purposes. Orchids, in most cases, are likely purchased as celebratory items. Chrysanthemums, by contrast, are generally used for funerals and the like.

However, this book is intended as a study of economics. Therefore, as mentioned above, we will examine from an economic standpoint the role of Japanese potted flowering plants by clarifying how demand changes commensurate to changes in income and prices.

Fig. 1－1: Volume of orchids and cyclamen

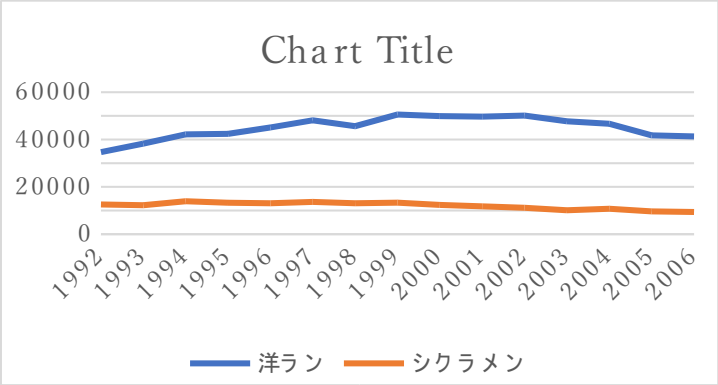
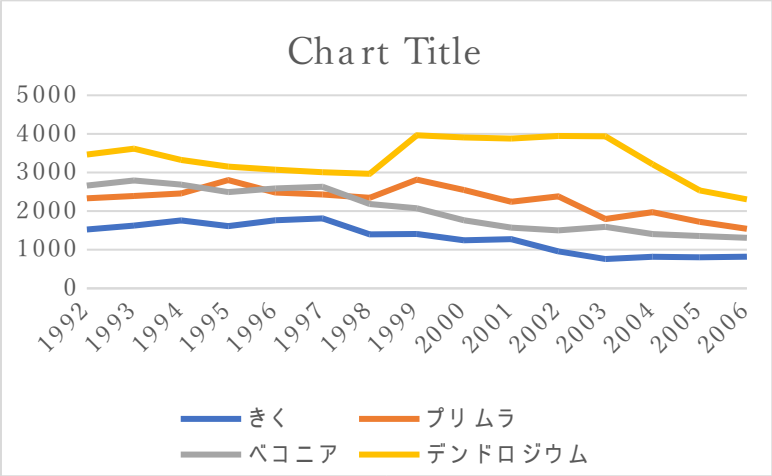


Fig. 1－2

2021 年 3 月 26 日

Volume of chrysanthemum, primula, begonia, and dendrobium



Source for Figs. 1－1 and 1－2: Flowering Plant Shipment Statistics (Ministry of Agriculture, Forestry, and Fisheries)

1. Theoretical explanation of income elasticity of demand and price elasticity of demand

We will begin by discussing the income elasticity of demand. Income elasticity of demand represents what percent change occurs to demand when income changes. In many cases, "of demand" is abbreviated, and the term "income elasticity" is used. Income elasticity is expressed with the following formula:

Income elasticity = △ D/D/△ Y/Y

D represents demand, and Y represents income. In this way, the formula describes the percent change in demand commensurate to the rate of change in income. For example, let us suppose that income increases by 2%, and the demand for some good then increased by 2.2%. This is described as:

Income elasticity = 0.0022/0.002
＝1.1

In other words, income elasticity is 1.1. When income increases by 1%, demand for goods increases by 1.1%. Positive change is referred to as "superior goods," and negative change as "inferior goods." In the case of superior goods, the common sense interpretation is that demand increases as income increases, but in the case of inferior goods, demand decreases in spite of income increasing. As income increases, the demand for certain goods decreases because that income is allocated to other goods that previously could not be bought.

In addition, even in the case of superior goods, if income elasticity is less than 1, demand does not increase much even if income increases, so the good is considered a necessity. If it is greater than 1, demand increases even more commensurate to increased income, so the good is regarded as a luxury.

The concept of price elasticity of demand is used to describe the above. This represents the percent change in demand relative to price changes. Generally speaking, it is referred to as price elasticity. Given a good with a price of P, price elasticity is defined with the following formula.

Price elasticity = —△ D/D/△ P/P

The negative sign is used because if prices increase, demand decreases, so expressing this as △D/D/△P/P alone would imply a negative. This can be compensated for by using a negative sign. For example, when prices rose by 1%, let us suppose that demand fell by 1.1%. This concept is expressed as:

Price elasticity = - (-0.0011/0.01)

＝1.1

In the case of the good above, when the price changes by 1%, demand changes by a factor of 1.1. When price elasticity is less than 1, the good is deemed a necessity; when it is more than 1, it is deemed a luxury. For the former, consumers require the good regardless of price changes, so demand does not decrease markedly. In the latter case, people can live without it, so they may choose to refrain from purchasing if the price increases.

When price elasticity is less than 1, it is considered inelastic; when it is greater than 1, it is considered elastic. However, given that when prices increase, demand decreases, price elasticity is usually positive, but there may be cases where it is negative. Those goods are referred to as Giffen goods.

3. Income elasticity of flowers

Taking the above into account, are Japanese flowering plants superior or inferior goods? Supposing they are superior goods, are they necessities, or luxuries? Below are findings by Go Igusa, Katsushi Mizuno, et al (2019). The data can be found in Table 1－1.

Table 1－1: Income elasticity of flowering plants

Orchid	1.1432
Cyclamen	0.4325
Chrysanthemum	0.7203
Primula	1.0819
Begonia	0.5276
Dendrobium	1.4592

Source: Table 1－1 and 1－2, analysis by Go Igusa, Katsushi Mizuno, et al (2019)

The income elasticity for all of the flowering plants mentioned here was a positive value, so it can be said that they are all superior goods. In addition, if the income elasticity is greater than 1, it is considered a luxury cultivar, and if it is less than 1, it is considered a common cultivar (a necessity). Luxury cultivars include orchids and dendrobium, while common cultivars include cyclamen, chrysanthemum, and begonia. Primula likely falls on the edge between these two. Recently, orchids are more frequently purchased for decorative use in the home, but they remain an abiding staple of celebrations, so they fall into the luxury category. Cyclamen, chrysanthemum, and begonia are a common flower that is generally purchased at a florist and brought home.

Let us next look at changes in the share of these flowers. This is a comparison between flower types, so w,

representing share, is an average.

Table 1－2: Changes in share

	Orchid	Cyclamen	Chrysanthemum	Primula	Begonia	Dendrobium
1992	0.6061	0.2195	0.0266	0.0407	0.0465	0.0606
2006	0.7293	0.1653	0.0144	0.0272	0.0231	0.0407
Change	0.1232	-0.0542	-0.0122	-0.0135	-0.0234	-0.0199

Only orchids exhibited a positive change in share, i.e., increased share. Between 1994 and 200, 20M orchids were produced. By contrast, 17M cyclamen were produced in the first half of the 1990s, and this number remained constant at 20M in 2000 and beyond. However, starting in 2006, its share of the total began to decline. With people increasingly not shopping for flowers today, it appears that orchids, given their abiding use for celebratory occasions, were the only type to remain consistent.

4. Price elasticity

Next, we attempted to calculate the price elasticity of flowers. This is described in Table 1－3.

Table 1－3: Price elasticity of flowers

Orchid	Cyclamen	Chrysanthemum	Primula	Begonia	Dendrobium
0.7984	0.7574	0.986	0.4313	0.629	－0.1359

Data used: wholesale volume and wholesale prices, 1992-2006

Calculation method: OSL regression analysis of wholesale volume rate of increase = a × wholesale price rate of increase, where a = price elasticity

All flowers but dendrobium showed a positive change. Dendrobium is treated as a Giffen good, with demand not increasing despite a decreased price. Chrysanthemums exhibited the highest price elasticity. In that case, demand increased at the highest rate commensurate to falling prices. Prices did not appear to markedly affect demand for primula. Perhaps due to the fact that they are often used for celebratory occasions, orchids did not show a notable change in the psychology of buying patterns commensurate to price changes.

5. Conclusions

In this chapter, we calculated the change in income elasticity, price elasticity, and share of potted flowering plants typically bought in Japan. Orchids were the most stable in terms of price elasticity and change in share. However, in

terms of price elasticity, orchids did not show a marked response to price changes.
In summary, we have learned methods of exploring the characteristics of goods: income elasticity and price elasticity. You should use income elasticity and price elasticity as tools to evaluate goods traded in other markets. You can use the findings gained through this chapter to inform your analyses of various markets.

Footnotes
(Note１） This chapter has been adapted based on remarks based by Katsushi Mizuno in a paper by Go Igusa, Katsushi Mizuno, et al (2019). The data on price elasticity represents a new calculation.

Exercise
Q. There are limited practical examples of Giffen goods. Can you find a working example of a Giffen good?

However, the following points should be noted: Generally speaking.
Consumption (demand) = domestic + foreign goods.
At the production level,
Consumption = Domestic shipments + net imports (imports - exports)
At the retail and wholesale level,
Consumption = retail volume = wholesale market volume + other transactions (direct sales, contract cultivation, etc.)
Therefore, the data must be manipulated according to the context. For the purposes of this example, we opt to ignore the existence of other countries. Foreign countries will be incorporated in subsequent research.

Ⅱ. Flower economy of Japan 2: A behavioral economic method for increasing tourism to sites with Cypripedium macranthos (See Note 1)

Foreword
One aspect of Japan's economic culture is not only the practice of purchasing flowers, but going to see them. Rebun Island in Hokkaido Prefecture is home to a type of flower that blooms nowhere else. That flower is the Cypripedium macranthos. This is a perennial plant in the Orchidaceae family. It is a flower with a core following, with areas known as prime habitats for Cypripedium macranthos showing considerable activity as tourist destinations during their short blooming period. Using a behavioral economic model that looks at regret aversion, we can see that tourists look forward to these rare flowers during the limited season they are available. Rebun Island has witnessed the economic impact of increased tourism thanks to this flower.
Incidentally, existing economic models presuppose that consumers act towards maximum utility, and companies

act toward maximum profit, whereas behavioral economics assumes that humans are driven by emotion, so economic behavior is also driven by a psychology of emotion and not solely economic rationality.

However, in recent years, the number of tourists visiting Rebun Island has decreased. Given the flower's scarcity, we would expect people to visit in large numbers, out of regret aversion. Let us look at questionnaire responses to see why this behavioral economic concept failed to function. Ultimately, the reason is because the majority of people do not know about the existence of the Cypripedium macranthos. Let us examine the facts and consider methods of increasing tourists to the area.

1. Awareness of the Cypripedium macranthos

While there is considerable interest in this flower at the local level, to what extent is it known by the general public and tourists? To further clarify this, we conducted a questionnaire. Working with the Rebun Island Tourism Association and other groups, we administered the questionnaire to2－46 tourists (175 male, 371 female) visiting Rebun Island between June 2018 and the alpine plant blooming season. In November 2018, we commissioned ASMARQ Co., Ltd. to conduct the questionnaire to 300 members of the general public. The results can be found in Table 1.

Table 2－1: Comparison of awareness of the Cypripedium macranthos (number of people)
[Tourists (respondents: 538 members of the general public (respondents: 300))]

Response	Tourists	General public
Familiar with	362	40
Not familiar with	176	250

The results were calculated using the formula described in Note 2 in order to examine the ratio of responses between tourists and the general public.
A summary can be found in Table 2－2. (See Note 2)
Table 2－2: Comparison of awareness of the Cypripedium macranthos (extent of awareness)

Comparison	Z value	Difference
Tourists and the general public	13.8	Yes

The results found that there was a significant difference in awareness of the Cypripedium macranthos between tourists visiting Rebun Island and members of the general public on the Japanese mainland. This suggests that knowledge of the Cypripedium macranthos was a major factor in motivating people to visit Rebun Island.

2. Questionnaire on future interest in tourism

We also conducted a questionnaire asking tourists and the general public whether they would be interested in

incorporating the Cypripedium macranthos into their future tourism itineraries. The questionnaire was administered to both those with and without knowledge of the Cypripedium macranthos, and non-respondents excluded. The results can be found in Table 2－3.

Table 2－3: Comparison of touristic interest in the Cypripedium macranthos

[Tourists (respondents: 309)]

Response	Male	Female
Interested in incorporating in tourism	106	196
Not interested in incorporating in tourism	3	4

[General public (respondents: 219)]

Response	Male	Female
Interested in incorporating in tourism	79	70
Not interested in incorporating in tourism	36	34

Utilizing the formula described in Note 2, we evaluated the difference in the ratio of male to female tourists interested in incorporating the Cypripedium macranthos in their tourism itineraries. The results can be found in Table 2－4.

Table 2－4: Comparison of degree of touristic interest in the Cypripedium macranthos

Comparison	Z value	Difference
Comparison of male and female tourists	－0.15	N/A
Comparison of male and female members of the general public	0.32	N/A
Tourists and the general public	7.59	Yes

The results indicated no difference between males and females in both the tourist group and general public group

in terms of interest in incorporating the Cypripedium macranthos in travel itineraries. This seems to suggest that there would be no need to create different tourism PR strategies for men and women. The results also indicated a clear difference between tourists and the general public. The data show a difference in degree of interest in the Cypripedium macranthos between tourists to Rebun Island and members of the general public. In other words, the general public does not know of the Cypripedium macranthos and is therefore not interested in visiting.

3. Behavioral economic approaches to increasing tourism

In this way, despite its value, the Cypripedium macranthos is known by a limited few, so regret aversion fails to function as intended.

Let us consider what kind of publicity or promotional methods informed by behavioral economics could be used to allow tourists to become aware of the Cypripedium macranthos and show an interest in visiting. While traditional economics presupposes that humans behave in a rational manner and apprehend all information available to them, performing accurate calculations, behavioral economics posits that human behavior is based on feelings and emotions that are themselves based on irrational or incomplete information.

Below we propose and describe some behavioral economics methodologies ((1) to (4)) as means of increasing tourists to the area.

(1) Cypripedium macranthos PR making use of principles of loss aversion

Loss aversion is the psychology of not wanting to lose or miss out on something. For example, this could include products offered for sale during a limited time. If failing to go during the sale and buying a product later, the cost returns to the original sticker price, causing the buyer to feel a sense of regret. This leads them to be reluctant to buy. This is the underlying principle of loss aversion. Therefore, appealing to this logic could be done by pitching the point that the Cypripedium macranthos only blooms between May and June. One could convey that missing out on this opportunity would be a major loss. This leads people to want to take some action to avoid loss. Therefore, it would lead to an increase in tourists visiting to see the Cypripedium macranthos.

(2) Rebun Island PR making use of the Windsor effect

The Windsor effect is the psychological concept that a person trusts information more from a third party who is not related to something than from a person who is directly involved in it. One familiar example would be product reviews. Given that shopping online has become more frequent today, it is much more commonplace for people to read reviews written by other people, such as those linked on web pages. Therefore, reviews about Rebun Island and Cypripedium macranthos could be posted on web sites or in magazines as a way of sharing feedback from a wide range of people with a larger audience.

(3) Tourism promotion through use of psychological reactance

People's innate psychological reactance can be utilized as one method of promoting tourism to Rebun Island. One approach could be using advertising pitching the idea that "the Cypripedium macranthos is a delicate plant that is endangered, so you must come see it now." These phrases could be styled as "Just the place for those with a passion for flowers (Cypripedium macranthos, etc.)" or "A must-visit for those interested in nature." The wording seems to exclude a certain group of people, making Rebun Island and Cypripedium macranthos seem attractive and exclusive.

This could include comments made by a lifeguard on Rebun Island, who said that "We deliberately choose to withhold information about Rebun Island with the public." In that way, the remarks that "A place that people with an interest in seek out directly. As a result, it will likely see more inbound visitors" (June 2018) was a form of PR making use of psychological reactance.

(4) Rebun Island PR making use of the Barnum effect

The Barnum effect is a technique whereby people give high accuracy to descriptions of themselves that are in fact generic enough to apply to anyone. For example, many people would agree with the statement that they are "a person who feels comfortable in nature." The Barnum effect can be utilized to create advertising copy such as, "If you enjoy spending time in nature, come visit Rebun Island!!" This would lead a wide range of people to feel that Rebun Island is the destination for them. This is the opposite of the psychological reactance method used in behavioral economics (see 3 above) and can be said to be an orthodox advertising technique.

4. Conclusions

The focus of this chapter has been considering how to attract the general public, which has not thus far been interested in Rebun Island or Cypripedium macranthos, to the area for tourism. We began by conducting a comparative survey of tourists and the general public and elucidating differences in their awareness and opinions. The results were as follows.

1 When comparing the rate of awareness of Cypripedium macranthos between tourists and the general public, tourists were found to have a greater awareness.

1 In a comparison of degree of interest in incorporating Cypripedium macranthos into their tourism itineraries, existing tourists more strongly agreed with the notion.

This led to the finding that turning the general public into potential tourists is key. In addition, we utilized behavioral economics models to suggest ways of promoting the Cypripedium macranthos and increasing interest among tourists. This involved the use of loss aversion, the Windsor effect, psychological reactance, and the Barnum effect. The remaining challenge is to consider more behavioral economics solutions to the problem. We encourage you to try making your own suggestions.

Footnotes

Note 1: This chapter was adapted from Takumu Doi, Katsushi Mizuno, et al (2020) with the below additions

Note 2:

Attributes	Group 1	Group 2
In favor	f1	f2
Overall	n1	n2

Test formula (calculated z using the symbols in the table)z = (p1 - p2) / √p (1 - p)(n1 + n2) / (n1n2) however,

$$p = (f1 + f2) / (n1 + n2)$$

If the value of z is $-2 \leq z \leq 2$, a null hypothesis is used (no difference between Groups 1 and 2)

Exercise

Q. Satoshi Kawanishi (2016) describes various behavioral economic effects. Try using behavioral economic techniques other than those described herein to consider ways of bringing tourists to Rebun Island.

Ⅲ. Innovation: Producers and market -- total factor productivity

１． **Foreword**

In this chapter, we analyze the production side of the flower market in Japan, in particular the potted flower market (orchid, cyclamen, chrysanthemum, primula, and begonia; categories per the Flowering Plant Logistical Statistics Report). In recent years, flowers in Japan are undergoing changes in the way they are used by consumers. This includes shifts from use as gifts to ornamental purposes, and from ornamental purposes to childraising and developmental purposes. Per these changes, producers have continued to innovate. The first innovation came in the form of things like domestic refinements to bulb production, as well as systems for importing bulbs from overseas. The second innovation was selective breeding. Diversifying uses of flowers have called for a need for new varietals. This triggered innovation to create new flowers to meet certain needs. The third innovation was mass production. This allowed for greater productivity.

Innovation is generally interpreted to mean technological development. The degree of that progress is referred to as the rate of technical development. Here, we attempt to calculate that rate as concerns Japanese flowering plants. Therefore, in this chapter, we will explain how to measure the rate of technical progress in the context of production. The rate of technical progress is generally referred to as total factor productivity growth rate (hereinafter abbreviated as total factor productivity). We will begin by explaining how to obtain total factor productivity, and then use it to calculate the rate of technical progress in the flowering plant market. One unique aspect of flowers is that different types exhibit different degrees of technical progress. Orchids, for instance, have seen growing demand following changes to the way they are used, so there has been more technical progress on that front. By contrast, chrysanthemums and the like have shown a downward change. No technical progress has been pursued for the latter. Let us learn about methods of measuring the rate of technical progress in order to learn more about the above.

1. Theory of total factor productivity: production function and marginal productivity theory

We will first explain how to obtain total factor productivity in steps.

1) Production function

First we discuss the production function. The volume of production varies with the quantity of goods that have been input. This relationship is described using what is called a production function. Y is the volume of production, K is the amount of capital stock input, and L is the amount of labor input. The production function is therefore the following formula:

$$Y = f\ (K,L)$$

Y is an equation of K and L.

Suppose that b is multiplied by K and L.

$$b^n Y = f\ (bK, bL)$$

A valid rendering of this formula is referred to as a homogeneous function of n degree, or homogeneous n-order function. If n = 1, it is referred to as a homogeneous first-order function, and is invariant in terms of scale; i.e., it implies constant returns. If n>1, returns increase in terms of scale, and if n<1, returns are diminishing in terms of scale.

2) Marginal productivity theory

One fundamental logic in terms of production theory in economics is marginal productivity theory. This theory is a means of expressing the maximization of profits. π is profit, p is the price of the product, r is the capital stock value, and w is the price of labor. If profit is the amount of production minus costs (by excluding the cost of capital and the cost of labor), it can be expressed by the following formula.

$$\pi = pY - (rK + wL)$$

Returns are considered greatest when the partial derivative of K and L is zero.

$$\partial\pi/\partial K = p\partial Y/\partial K - r = 0$$

$$\partial\pi/\partial L = p\partial Y/\partial L - w = 0$$

Therefore, the above can be written as follows.

$$\partial Y/\partial K = r/p$$

$$\partial Y/\partial L = w/p$$

∂Y/∂K is referred to as marginal product of capital (MPK), and ∂Y/∂L as marginal product of labor (MPL). Here, the marginal product of capital is equal to the relative value of capital, and the marginal product of labor is equal to the relative price of labor. Thus, an expression of the relationship in which marginal productivity is equal to the relative price under profit maximization is called marginal productivity theory.

3) First-order homogeneity and zero profit

According to the theory of economics, under perfect competition, when the production function is a homogeneous first-order function, profits are zero.

$$pY - (rK + wL) = 0$$

In other words, this allows for the below relationship:

$$pY = rK + wL$$

3) Total factor productivity

Now that we understand the fundamentals, we can describe how to calculate total factor productivity.

1 Primary homogeneity of total factor productivity

Now we obtain the total differential of the aforementioned production function.

$$dY = \partial Y/\partial K \times dK + \partial Y/\partial L \times dL$$

The marginal productivity theory is substituted here, and the following variation used.

$$dY/Y = rK/pY\, dK/K + wL/pY\, dL/L$$

First-order homogeneity 2) is substituted here.

$$dY/Y = f_k\, dK/K + f_L\, dL/L$$

D X/X represents rate of growth or increase. For example, rate of economic growth could be expressed as d GDP/GDP. A common sense understanding of market forces can be described as follows.

Rate of production increase = fk × rate of capital increase + fl × rate of labor increase

However, the above must be true.

$$f_k = rK/(rK + wL)$$

$$f_L = wL/(rK + wL)$$

These proportions describe the percentage of capital costs accounted for in total costs, and the percentage of labor costs accounted for in total costs.

The rate of increase in production can be explained using factors other than capital and labor growth. These are referred to as residuals.

Rate of production increase = fk × rate of capital increase + fl × rate of labor increase + residual

In this case, the residuals that represent a factor other than increased capital and labor contributing to increased production are called total factor productivity. This can be expressed as ρ as:

ρ = rate of production increase - (fk × rate of capital increase + fl × rate of labor increase)

In total, this is the formula for total factor productivity growth rate. This corresponds to the rate of technical progress and is a method used to measure the same.

2　Total factor productivity of n-order homogeneity

In the case of n-order homogeneity, the formula for total factor productivity is as follows.

ρ = rate of production increase - nx (fk × rate of capital increase + fl × rate of labor increase)

The second part of the right side of the equation is multiplied by n, corresponding to the n from the production function with n-order homogeneity. (See Note 1)

２．Total factor productivity in practice: a comparison of technical progress

Let us use what we have learned above to measure the rate of technical progress in the flower market. Given that first-order homogeneity is unrealistic in the context of zero profit, we will examine the market in terms of n-order homogeneity.　The authors' paper (see Note 2) contains a detailed calculation of n for each flower type.

Table 3－1: Homogeneity of degree n

Orchid	1.1698
Cyclamen	2.3129
Chrysanthemum	1.0786

Primula	1.5692
Begonia	1.2119

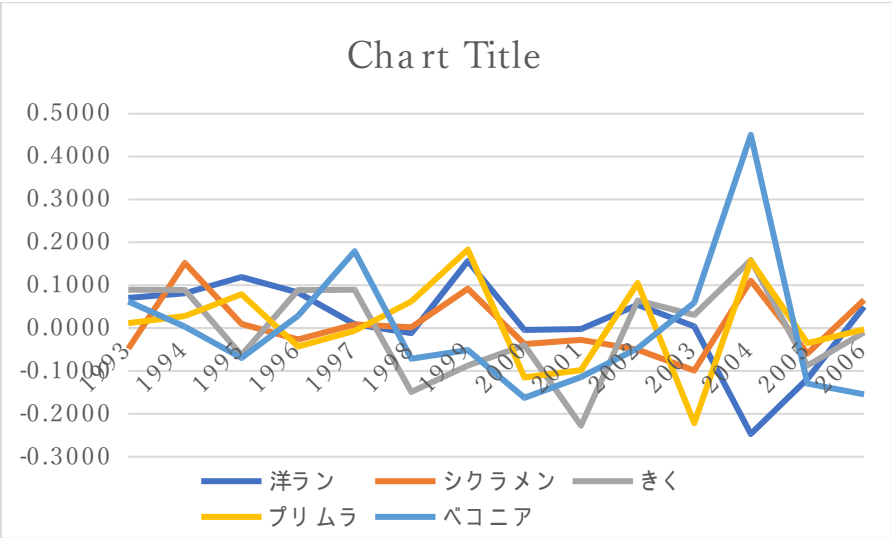
The data indicate that for all flowers, homogeneity of degree n was greater than 1, suggesting increasing returns of scale. Theoretically, it means that the more that is produced, the more profit is obtained, but if there is no demand, there is no increase in production and, in turn, profit. In basic terms, each farm is not simply able to turn a profit as such.

Next, let us calculate the rate of technological progress (total factor productivity growth rate) for each flower using the value of n.

The weighted average of the growth of input volume is deducted from the growth of overall production volume as fx x capital increase rate + fl x labor increase rate.

An n-order homogeneous total factor productivity formula was used to calculate the rate of technical progress for each flower. During the recession occurring between the late 1990s and 2006, the majority of flowers underwent negative technical progress. Perhaps under recessionary forces, producers struggled to allocate funds to technical development.

Fig. Trends in technical progress in the flower market



The annual average of rate of technical progress in flowers (total factor productivity) is as follows.

Orchid	Cyclamen	Chrysanthemum	Primula	Begonia
0.0173	0.0065	-0.0040	0.0072	-0.0014

The annual average for orchids is the largest at 1.7%. Orchids can now be mass produced thanks to cloning

technology. By contrast, technical progress for other flowers has not been as pronounced. While chrysanthemum and begonia show a negative change, they are respectively 0.4% and 0.1%, so we cannot draw from this the conclusion that the technology has itself declined. However, the lack of technical progress does illustrate that flower agriculture remains a cottage industry.

5. Conclusions

We learned two key points here about flowering plants. The first was that all of the flowers showed increasing returns of scale. Increasing the input volume means that the production volume will increase to a degree in excess of the input. This appears desirable, but in fact this tends to point to an immature state, such as the early or small stages of industry, with low technical capabilities, where more revenue is generated the more volume is produced. However, even if you produce at maximum capacity, you cannot turn a profit if there is no one to buy the product. Mature industries are considered those in which diminishing returns of scale are seen in terms of non-zero returns.

Additionally, none of the flowers under discussion can be said to have undergone significant technical progress. To a glancing extent, orchids have undergone some technical development, but it is not substantial.

For the sake of argument, we have ignored imports, but imported products play a competitive relationship against domestic production volume. Ignoring that aspect leads to issues that must be explored in subsequent research.

Many flower growers concurrently produce other crops, so they may be producing other goods. If the other crops turn a greater profit, they may elect to decrease production of flowers and in turn increase that of other products. A future trajectory for this research will be investigating to what extent the above affects our model.

However, total factor productivity allows for visualizing the rate of technical progress, so it is often used in the field of empirical analysis.

Exercise

In this chapter, orchids were treated as luxury goods. If buying 5,000 JPY worth of orchids, how would you use them?

Footnotes

Note 1: Created based on Katsushi Mizuno et al (2019)

Note 2: From calculations in Katsushi Mizuno et al (2019)