



BANK OF JAPAN

Development of Price Indexes for “Research and Development” and “Intellectual Property Licensing”



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Introduction

Why measure prices of knowledge-based activities?



Knowledge-based activities, including research and development (R&D) and intellectual property (IP)-related activities, have long contributed positively to economic activity.



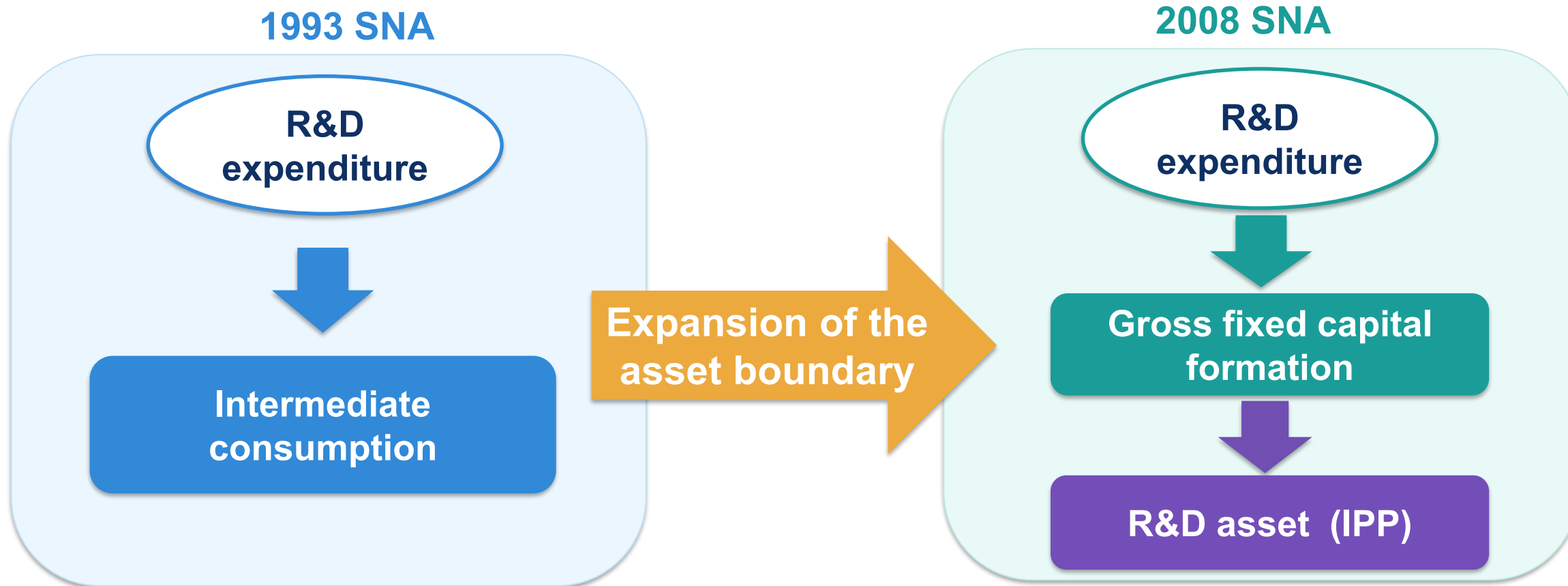
Their value lies in the knowledge they generate, which contributes to future production and generates economic benefits over time.



R&D and IP licensing are two important examples of knowledge-based activities.

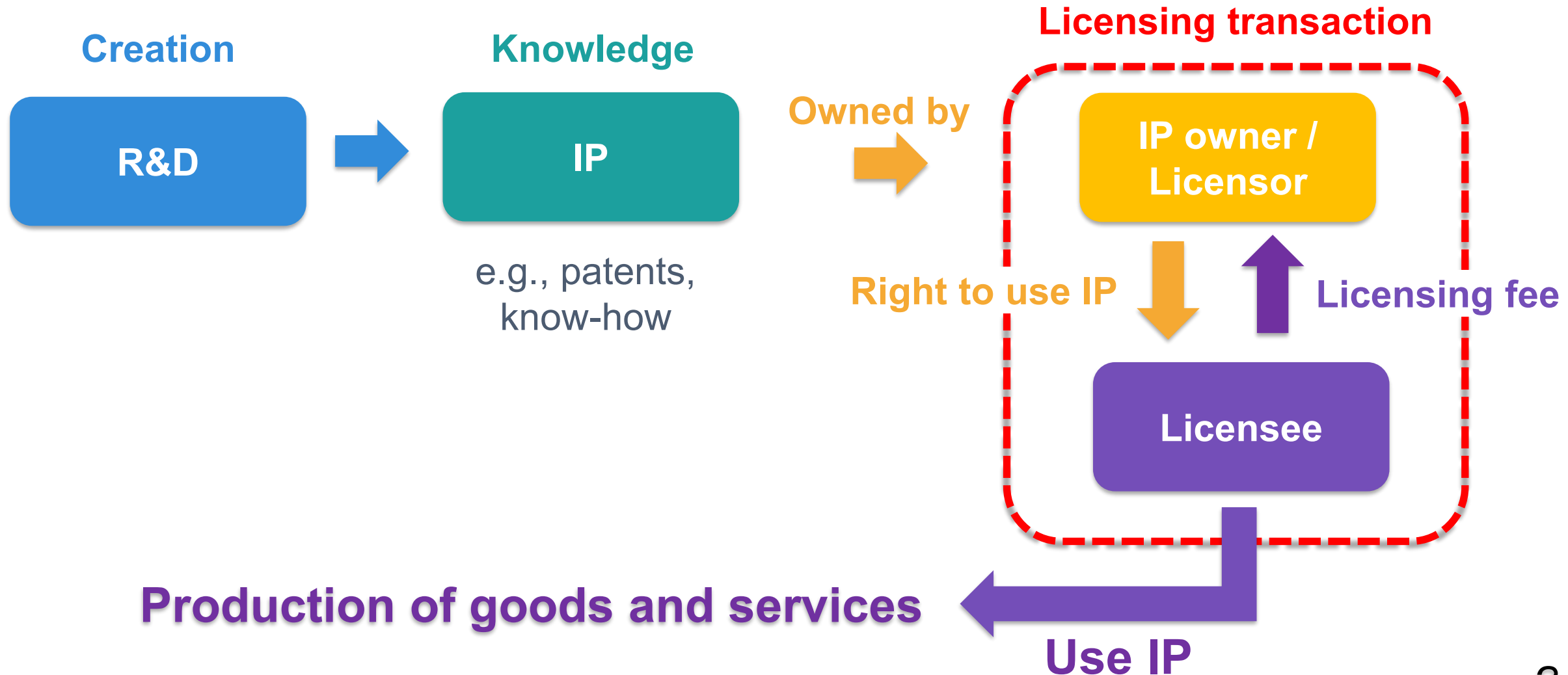


R&D in the SNA: From Intermediate Consumption to Capital Formation

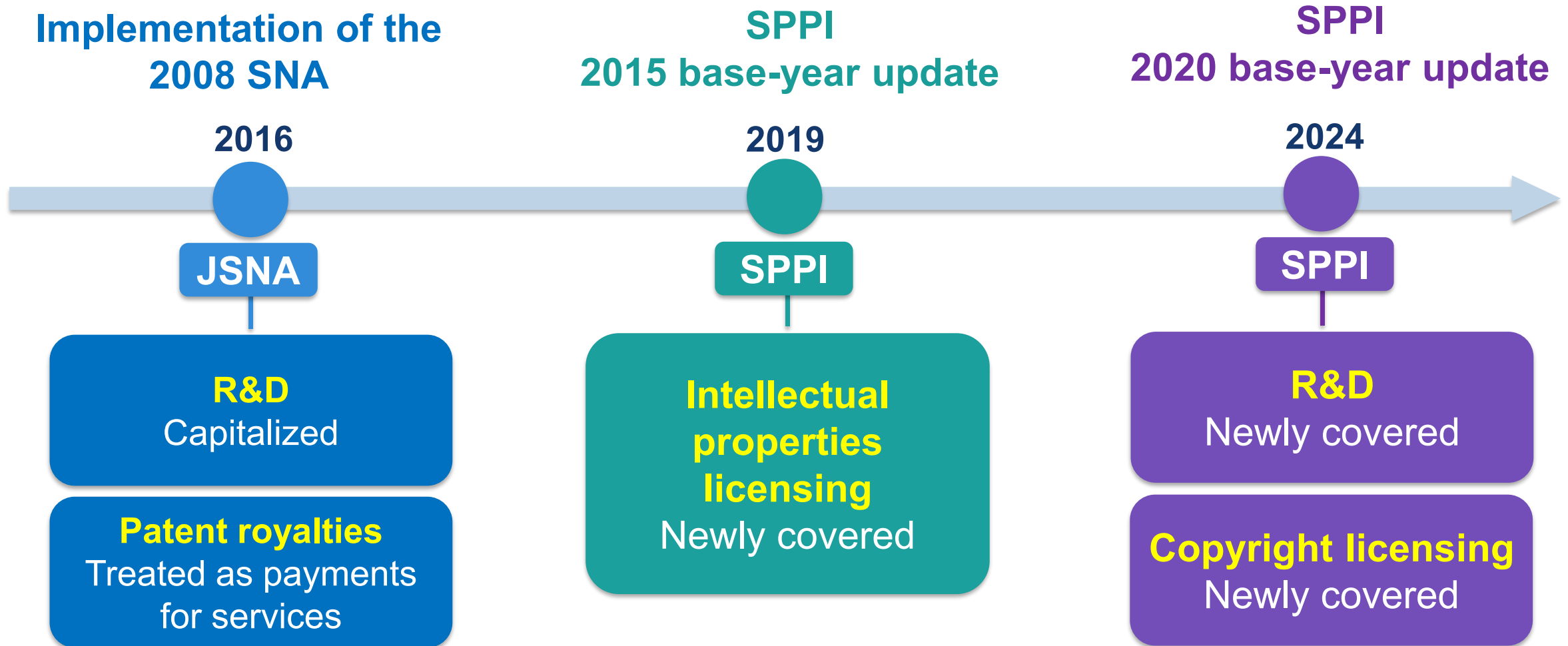


The 2008 SNA expanded the asset boundary to include R&D as an intellectual property product (IPP).

From R&D to IP Licensing



Japan's Progress in Developing R&D and IP Licensing Statistics



Statistical coverage of R&D and IP licensing has gradually expanded in Japan.



R&D Price Measurement

Challenges in Measuring R&D Prices

R&D projects are highly customized,
making it difficult to maintain constant quality over time.



MODEL PRICING

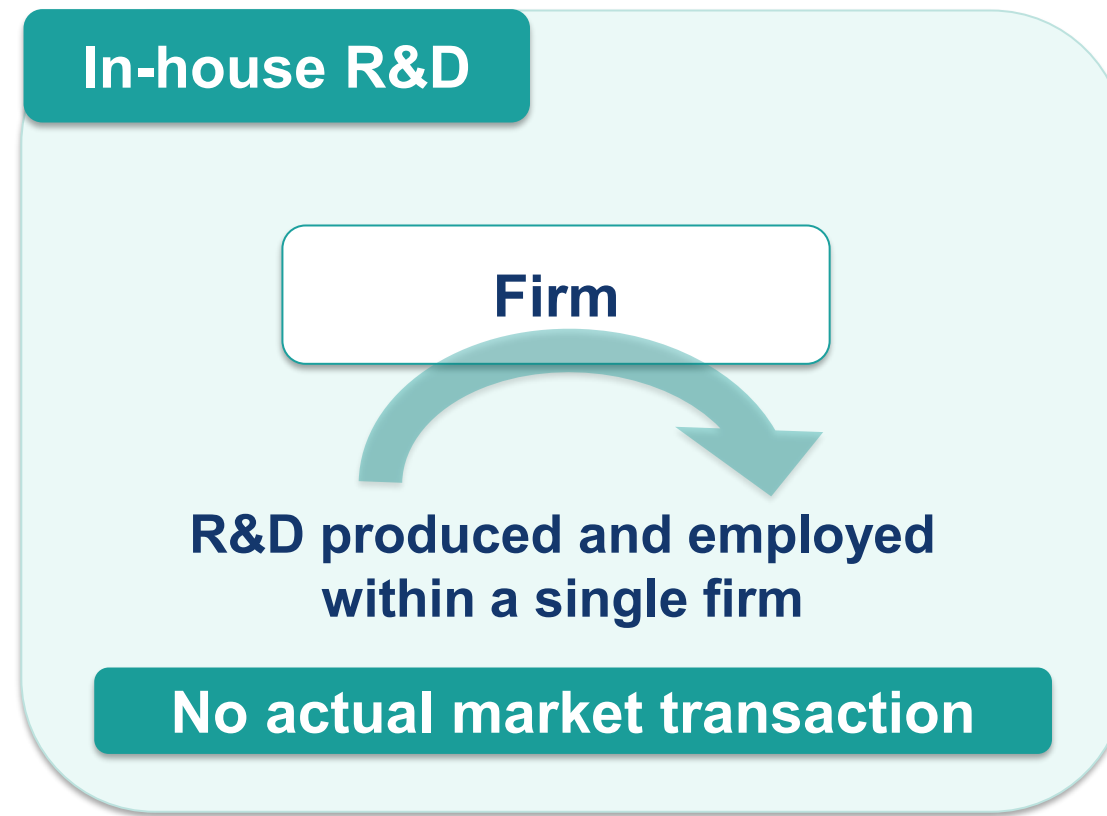
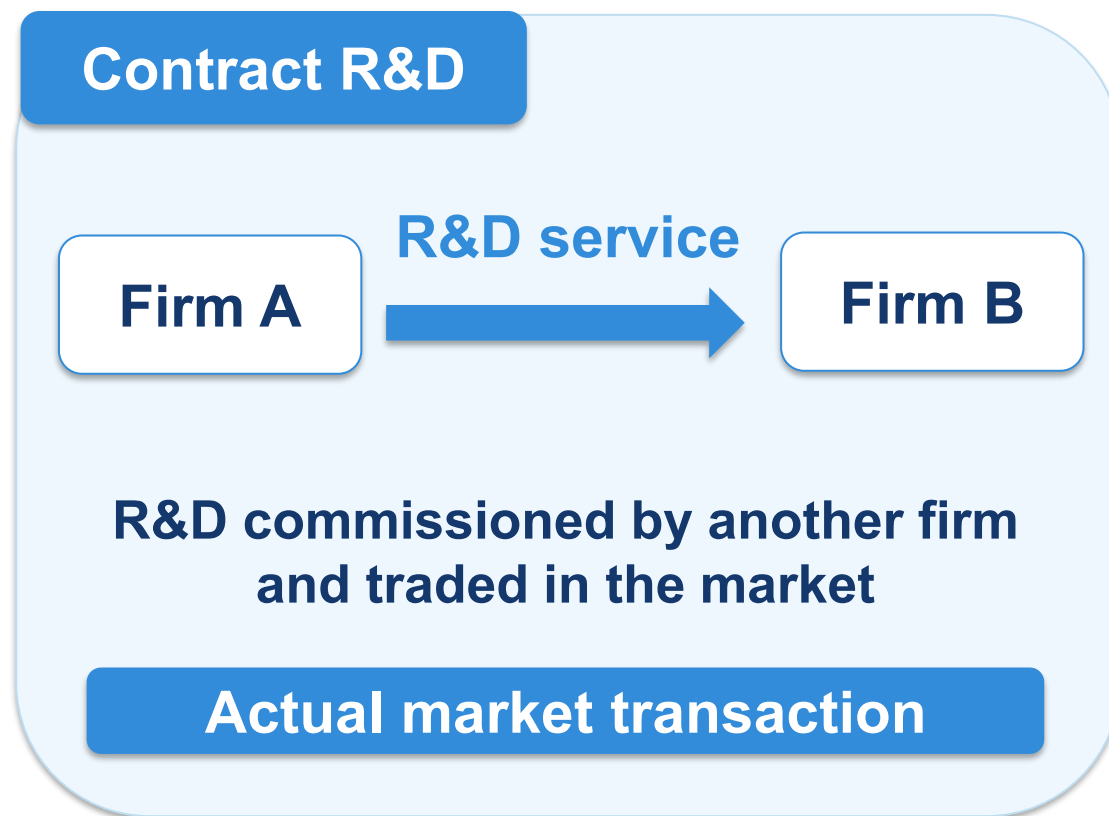
A representative R&D project is selected from each respondent,
and its price is tracked over time.

Select a
Representative
R&D project



Track
Price changes
over time

Coverage of the R&D Price Index



Because it is not market-based, in-house R&D generally falls outside the standard scope of the SPPI. However, it is covered in the SPPI as an exception to ensure consistency with the treatment of R&D in the Japanese National Accounts (JSNA).

Why Include In-house R&D in the SPPI?

1. Significant share in total R&D activity

In-house R&D is a major component of R&D activities in Japan.

Its inclusion in the SPPI is essential comprehensive measurement of R&D services.

2. Deflator needs & SNA consistency

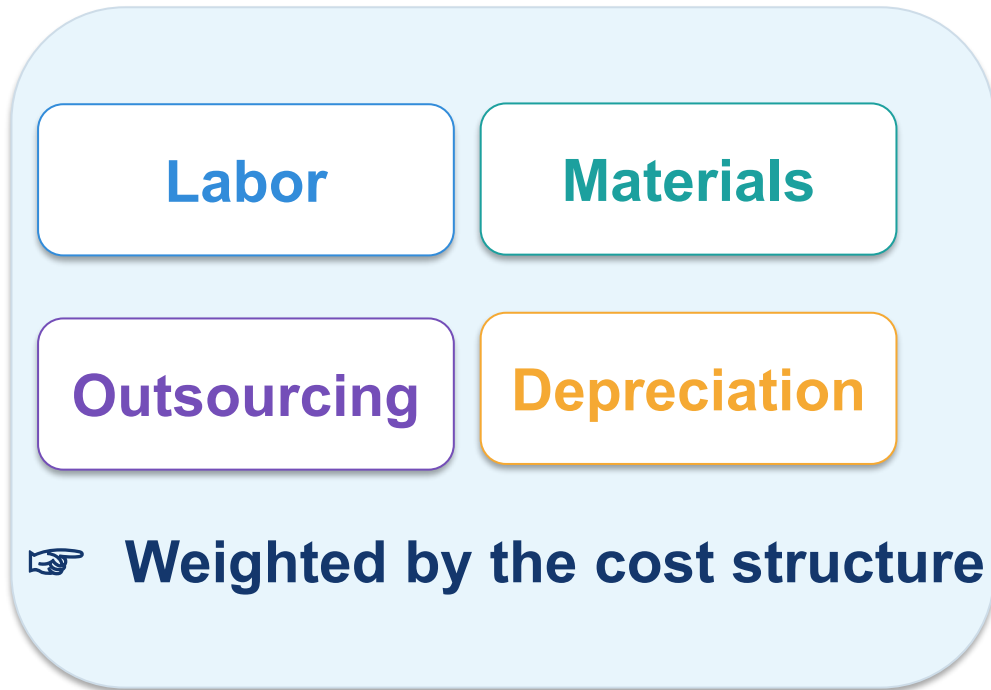
In-house R&D index plays a crucial role as a deflator for R&D investment.

Its inclusion in the SPPI is consistent with nominal measurement in the JSNA.

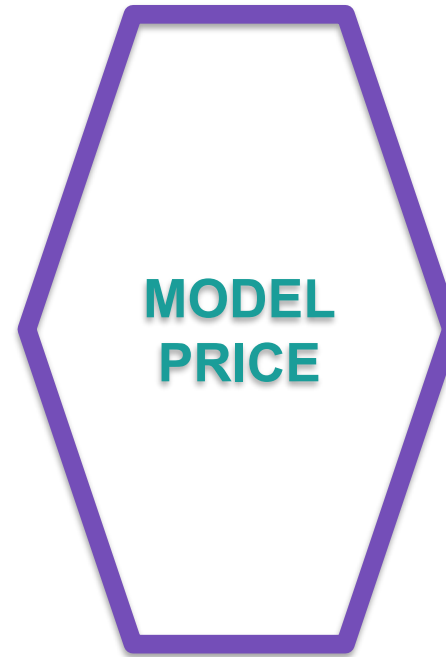
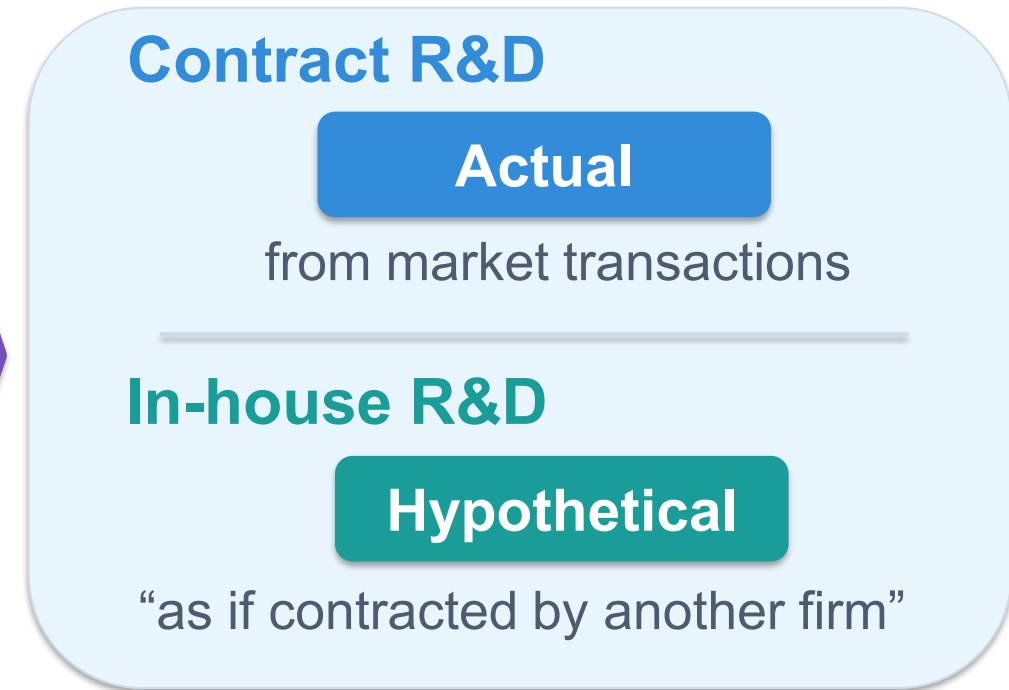
How Is the Model Price Constructed?

The model price consists of two components.

① Build the input-cost basket



② Add the markup



$$\text{Input costs} \times (1 + \text{markup rate})$$

How Are Input Costs Measured?

Cost Share

The cost structure of a representative R&D project is obtained **from respondents**.

Labor

Materials

Outsourcing

Depreciation

× Price movements of each cost component

Labor cost information
obtained from respondents

Relevant materials
price index

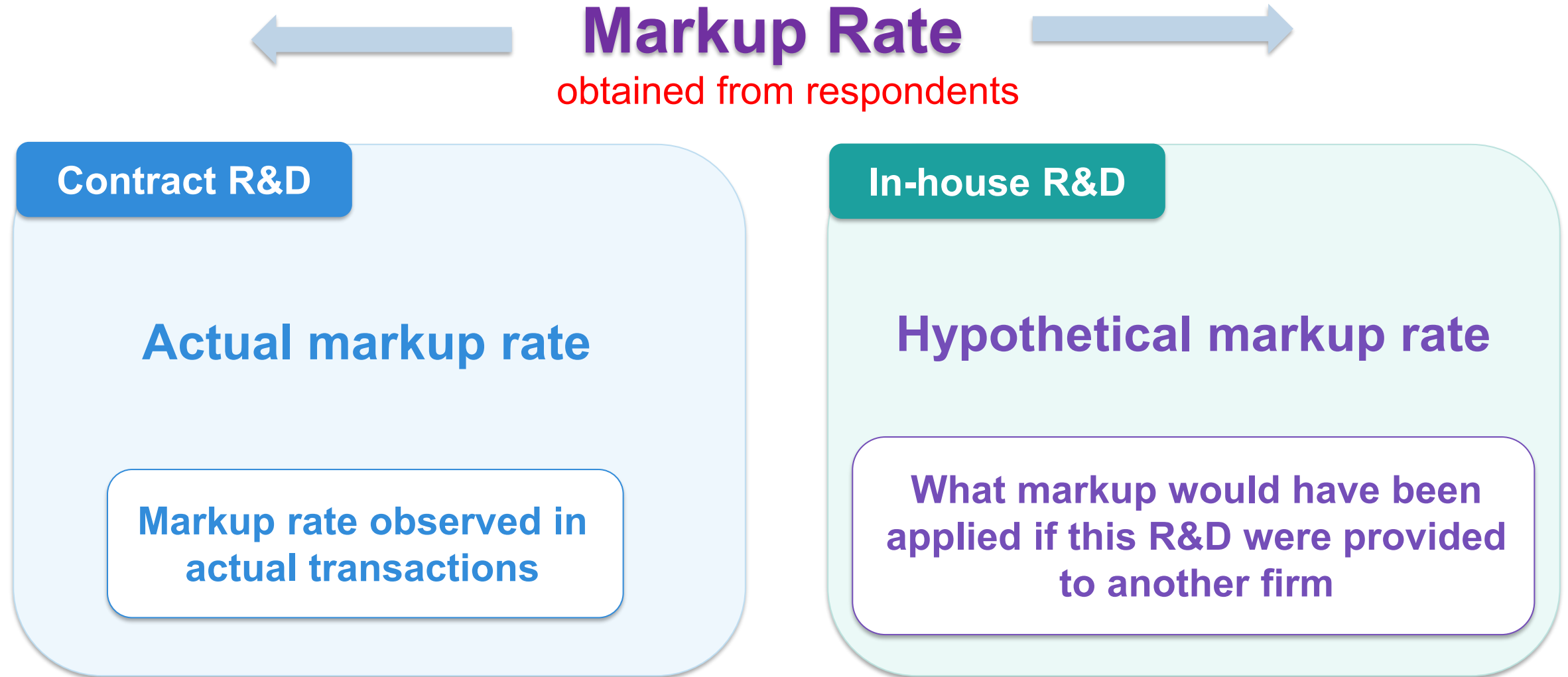
Relevant price index
for outsourced services

Relevant price index
for research equipment

Σ (Cost share × Price movement)

Input Costs

How Is the Markup Rate Measured?





Illustrative Example of R&D Model Pricing

Example: a representative in-house R&D project at an automobile manufacturer

INPUT COSTS

Component	Share	Price Index	
		Month T	Month T+1
Labor	60%	100	→ 102 (+2.0%)
Materials	10%	100	→ 104 (+4.0%)
Outsourcing	20%	100	→ 101 (+1.0%)
Depreciation	10%	100	→ 100 (0.0%)

×

MARKUP RATE

Hypothetical markup rate
5% (Month T)
↓
8% (Month T+1)

Month	Input Costs	Markup	Model Price
T	$0.6 \times 100 + 0.1 \times 100 + 0.2 \times 100 + 0.1 \times 100 = 100$	5%	$100 \times (1+0.05) = 105.0$
T+1	$0.6 \times 102 + 0.1 \times 104 + 0.2 \times 101 + 0.1 \times 100 = 101.8$	8%	$101.8 \times (1+0.08) = 109.9$

Data Sources and Update Frequency for the Model Price

Annually

From respondents

Cost structure & Cost shares

Labor cost movement

Markup rate

representative R&D model

e.g., Automotive R&D: growing share of software development

Quarterly

Updated by BOJ

Price indexes for input costs

Materials

Outsourcing

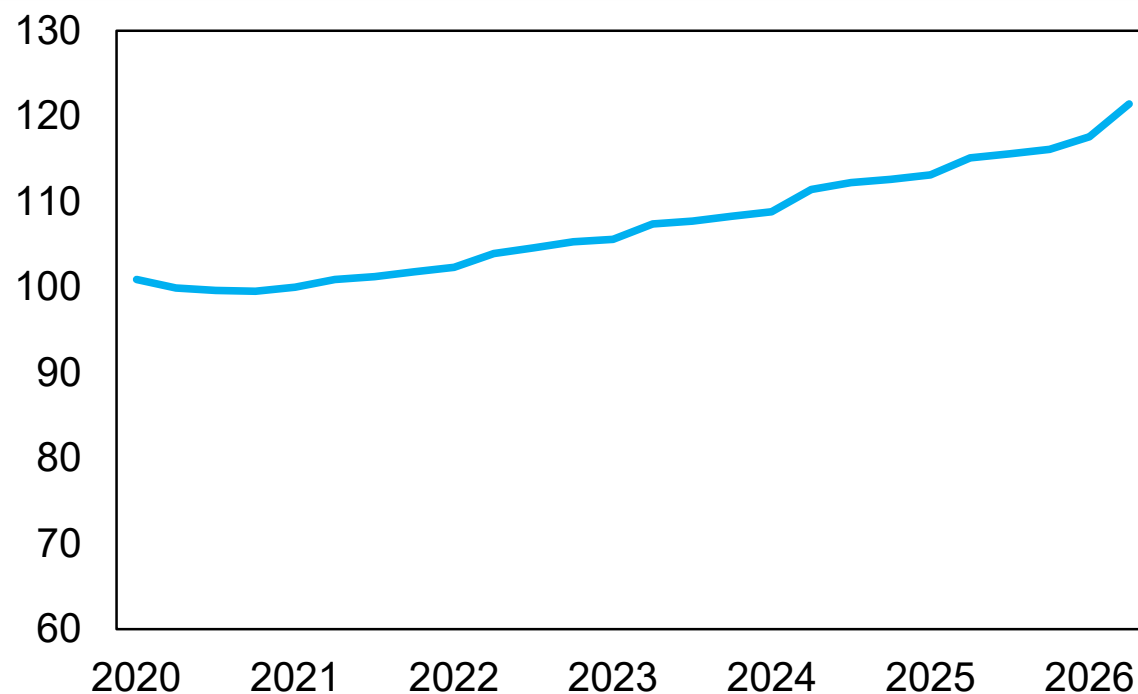
Depreciation / equipment

👉 **The use of price information also helps reduce the reporting burden.**

How Has the R&D Price Index Evolved?

The R&D Services Price Index is published quarterly, taking into account both the need for quarterly deflators in national accounts and data availability constraints for some cost components.

Research and development Services Price Index 2020 = 100, Quarterly



Source: Bank of Japan, Services Producer Price Index (2020 base).

Key observations

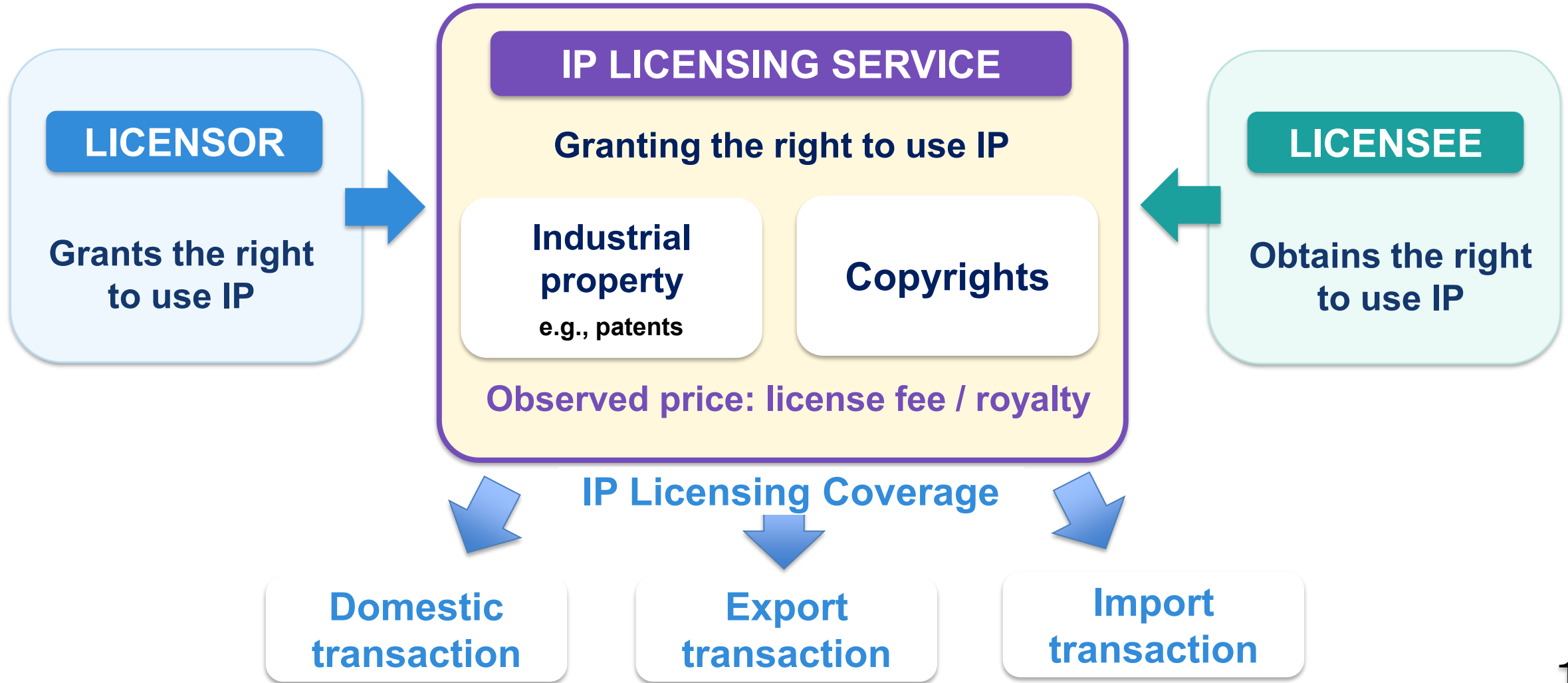
- ✓ The index has increased mainly due to higher overseas labor costs amid yen depreciation.
- ✓ The markup rate remained broadly stable.



IP Licensing Price Measurement

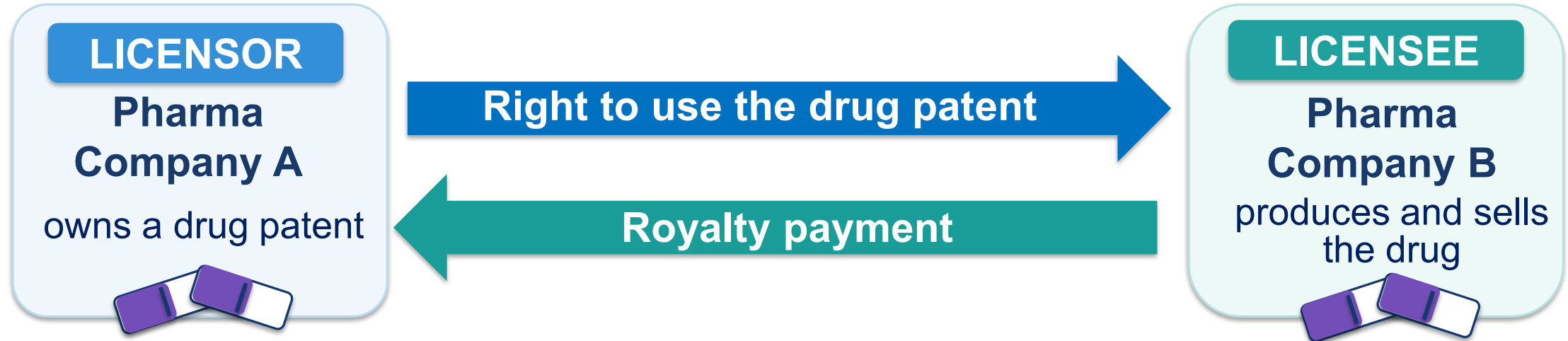
What Does the SPPI Measure for IP Licensing Services?

SPPI TARGET TRANSACTION



How Does a Royalty-Based Patent License Work?

A Typical Case: Patent Licensing (Industrial Property)



How is the payment determined?

$$\begin{array}{ccccc} \text{Drug sales} & & \text{Royalty rate} & & \text{License fee} \\ \text{¥100 million} & \times & 5\% & = & \text{¥5 million} \end{array}$$

MEASUREMENT ISSUE

The license fee also rises
when more drugs are sold.

Quantity changes $\neq$ price changes

Challenges in Measuring IP Licensing Prices

Measurement Task

Remove the quantity effect and isolate the price of the licensing service

1 Total Royalty Payment

$$\begin{array}{|c|} \hline \text{License fee} \\ \hline \text{total royalty payment} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Sales volume} \\ \hline \text{number of units sold} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Product price} \\ \hline \text{price per unit} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Royalty rate} \\ \hline \text{e.g., 5\% of sales} \\ \hline \end{array}$$

👉 The challenge is separating the price effect from the sales volume effect.

Divide Both Sides By Sales Volume



Turning a Royalty Payment into a Unit Price

2 Price Concept

$$\frac{\begin{array}{c} \text{License fee} \\ \text{total royalty payment} \end{array}}{\begin{array}{c} \text{Sales volume} \\ \text{number of units sold} \end{array}} = \begin{array}{c} \text{Product price} \\ \text{price per unit} \end{array} \times \begin{array}{c} \text{Royalty rate} \\ \text{e.g., 5\% of sales} \end{array}$$

→ royalty per unit sold

Key intuition

Dividing royalty payments by sales volume removes the quantity effect and yields the unit price of the licensing service.

How Do We Obtain the Two Price Components?

IP licensing price

=

Product price

×

Royalty rate

Product Price

Use an appropriate price index

price for the product or service covered
by the license

Updated From Price Statistics

Royalty Rate

Reported by the respondent

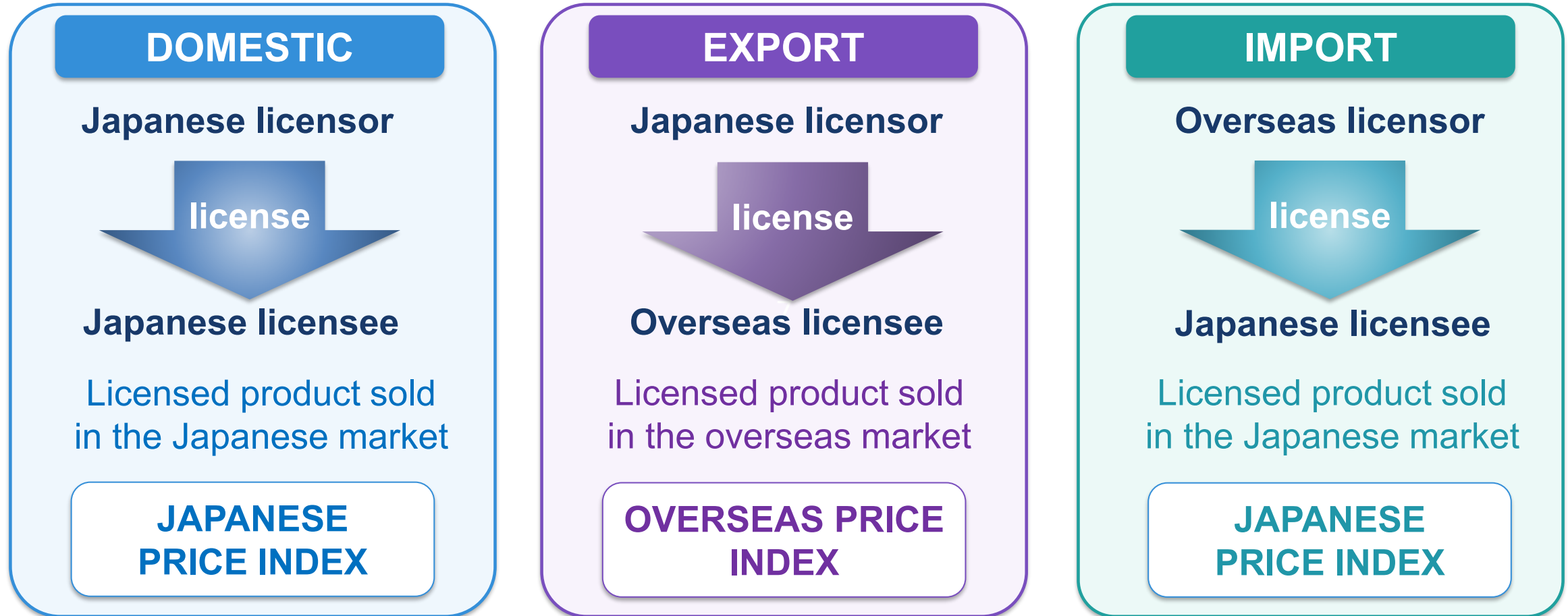
based on the terms of the
representative licensing contract

Collected From the Licensor

Practical Advantages 💡

Respondents do not need to report the total license fee or sales volume each period.

Selecting the Appropriate Price Index for the Licensed Product



Practical rule

Select the price index that reflects the market where the licensed product is sold, rather than determining it from the location of the licensor.

Other Contract Types for Industrial Property Licensing

Licensing arrangements other than royalty-based contracts

Per-Unit Fee

CONTRACT

Quantity
sold

×

Fee per unit

=

Total
fee



OBSERVED
DIRECTLY

SPPI PRICE SURVEY

Fixed Fee

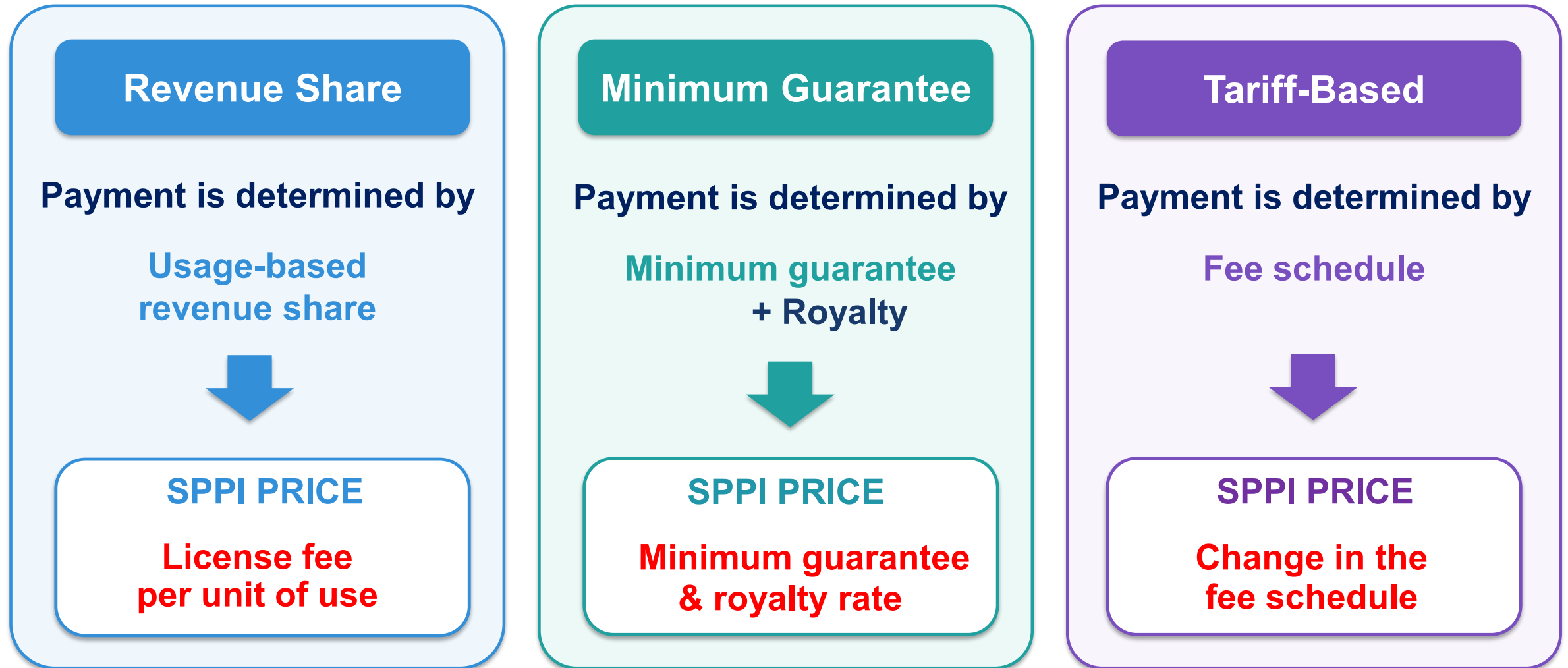
CONTRACT

Fixed license fee
for a specified period



SPPI PRICE SURVEY

Copyright Licensing: Contract Types and Pricing Structures



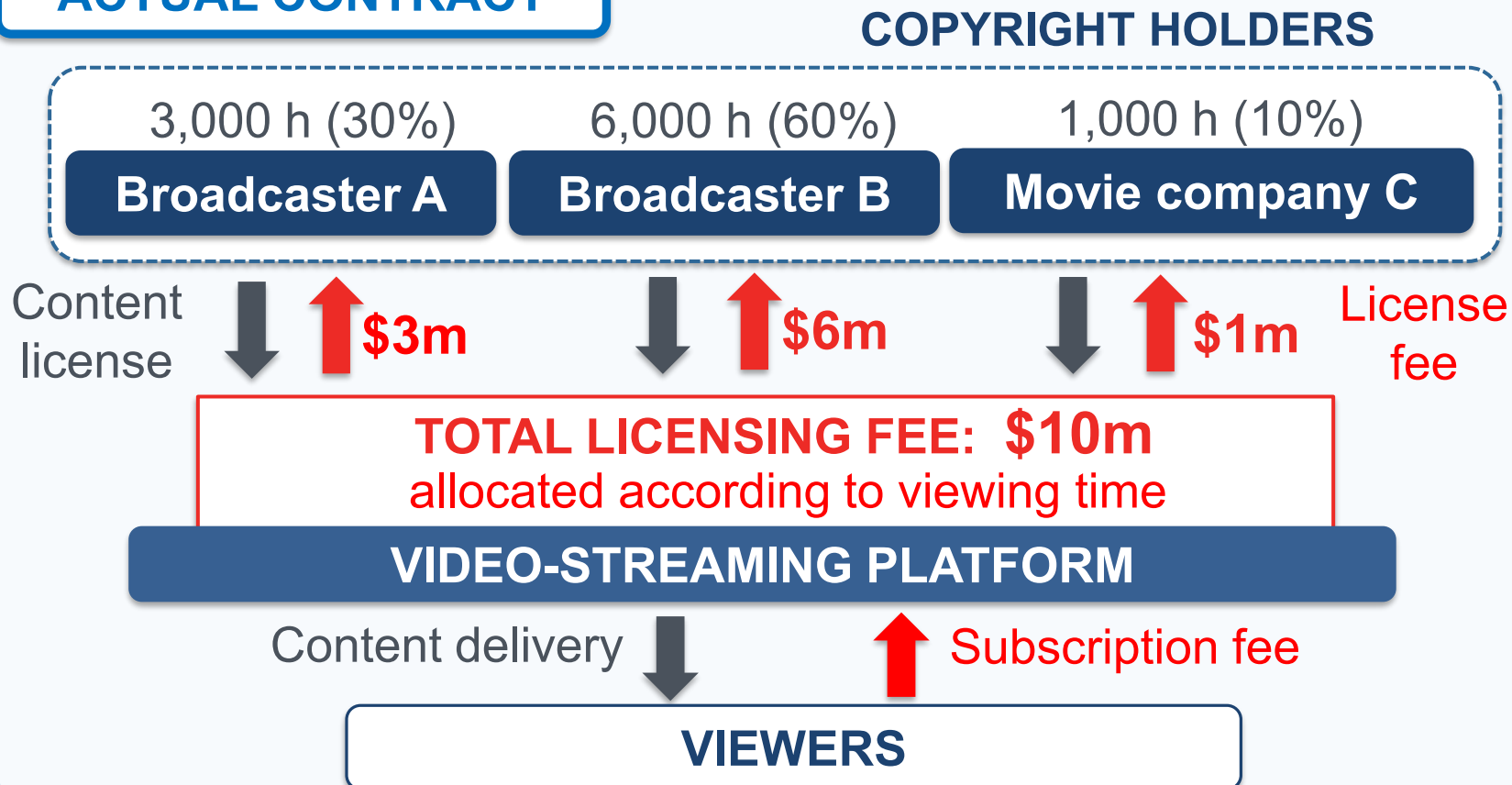
Revenue Share: From the Actual Contract to the Unit Price

Key Question

What should count as one unit of use — **a subscription or an actual viewing?**

Example: revenue sharing for video streaming

ACTUAL CONTRACT



BOJ PRICE CONCEPT

The service unit is measured by
Viewing time

$$\frac{\text{License fee}}{\text{Viewing hours}}$$

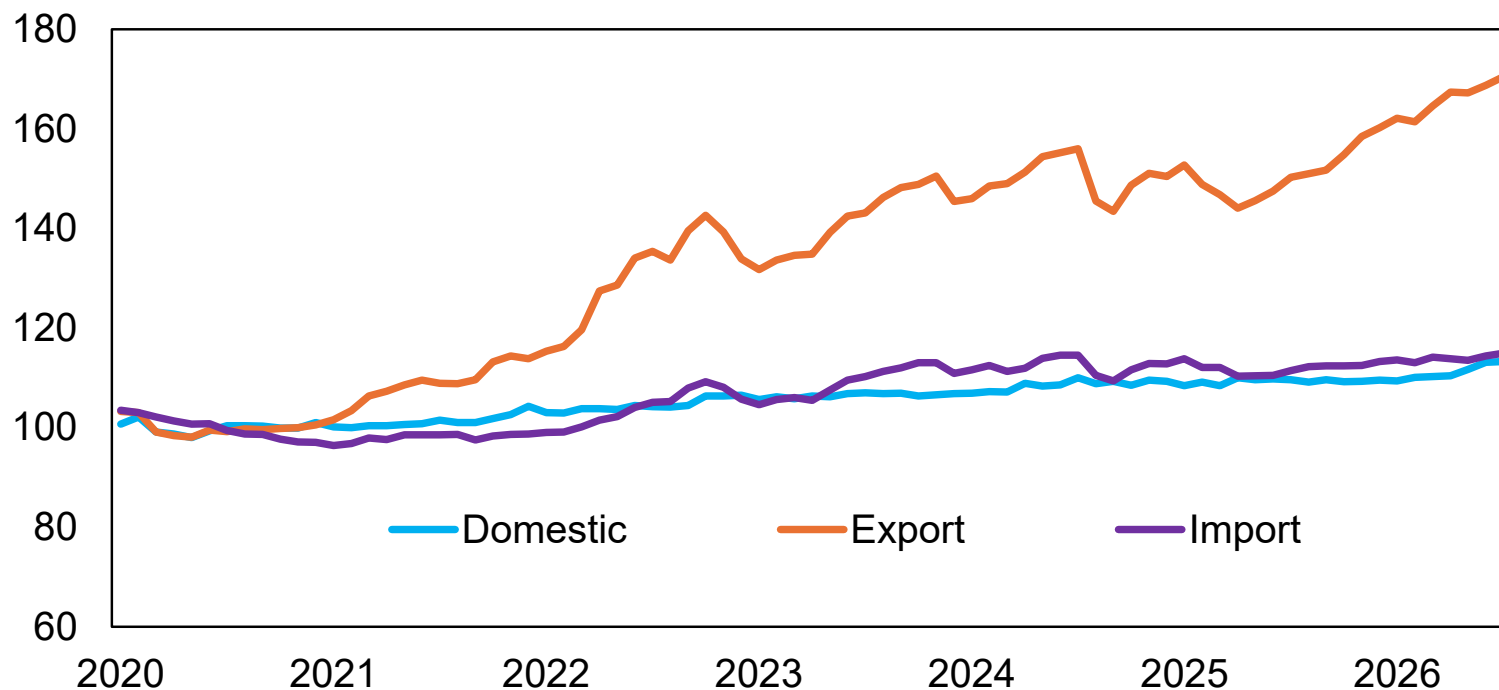
SPPI PRICE

License fee
per Viewing hours

How Has the IP Licensing Price Index Evolved?

IP licensing prices are compiled as the Intellectual properties licensing Services Price Index, rather than by type of intellectual property, such as industrial property rights or copyrights.

Intellectual properties licensing Services Price Index 2020 = 100, Monthly



Source: Bank of Japan, Services Producer Price Index (2020 base).

Key observations

- ✓ The export index has increased mainly due to higher prices of licensed products in overseas markets, reflecting yen depreciation.
- ✓ The domestic and import indexes have also risen gradually, supported by increases in domestic prices.



Key Lessons from Japan's Experience

1

START FROM THE ACTUAL TRANSACTION

Understand how the service is provided and how payment is determined.

2

COMBINE DIFFERENT DATA SOURCES

Combine respondent-provided data with appropriate external price indexes.

3

ADAPT THE METHOD TO A CHANGING ENVIRONMENT

Continuously review the measurement approach as technologies, contracts, and markets evolve.

Thank you