



A Study on Factors that Determine the Effectiveness of Toll Discounts

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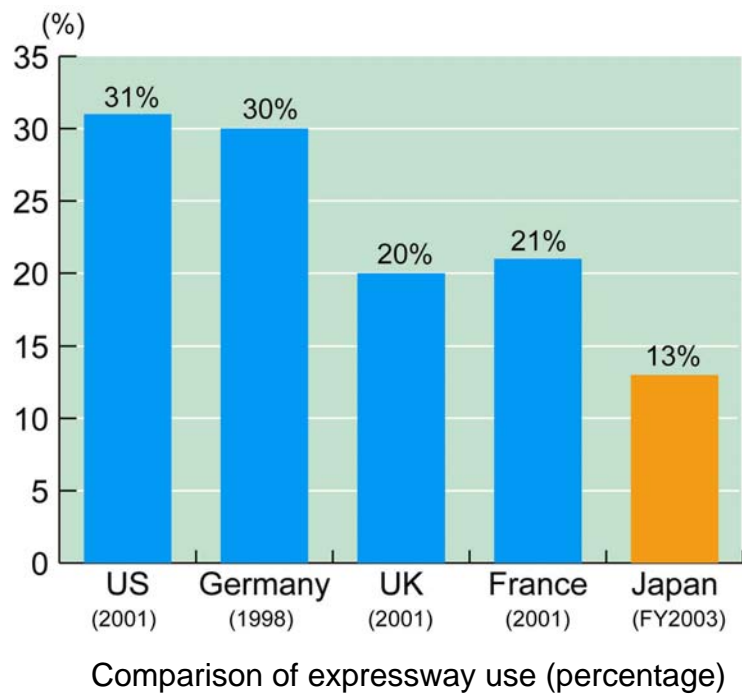
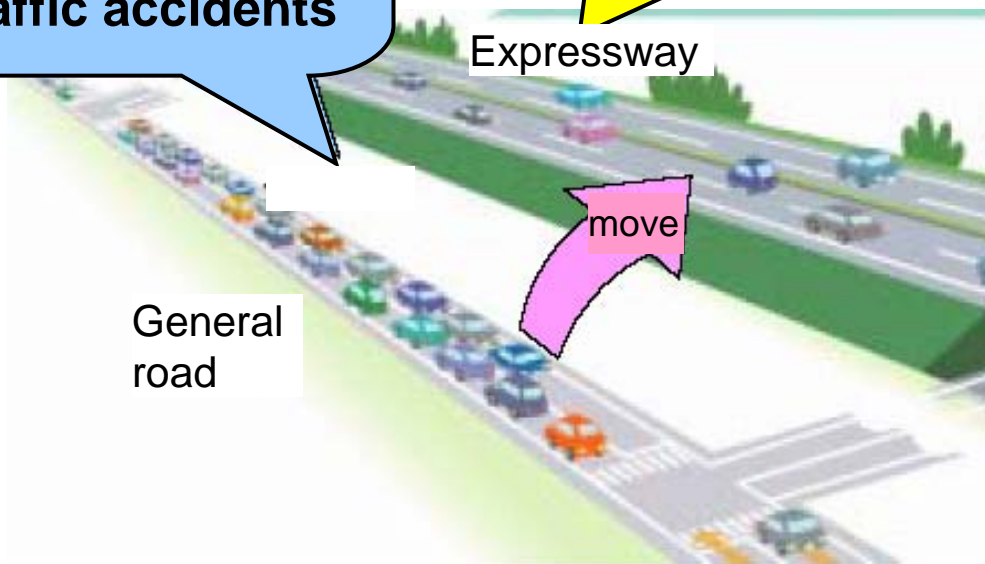
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1. Introduction

Expressways and national highways in Japan

- Congestion
- Environmental pollution
- Traffic accidents

- Margin for higher traffic volume
- High potential demand



Causes of low expressway use and corrective policies

1. Existence of “missing links”

2. Long intervals between interchanges

International comparison of average intervals between interchanges (ICs):

US: 5 km (free), Germany: 7 km (free), UK: 4 km (free), France: 10 km (toll)/5 km (free), **Japan: 10 km (toll)**

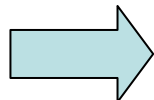
3. Relatively expensive toll charges

International comparison of average toll per 1 km :

US, Germany, UK: Free

France : €0.052

Japan : €0.16



Diverse and flexible toll systems

Objectives of this study

We analysed the results of flexible and diverse toll systems.

Objectives

- to grasp the tendencies in growth of traffic volume on expressways.
- to extract factors that decide growth of traffic volume on expressways.



2. Implementation & effects of toll discounts

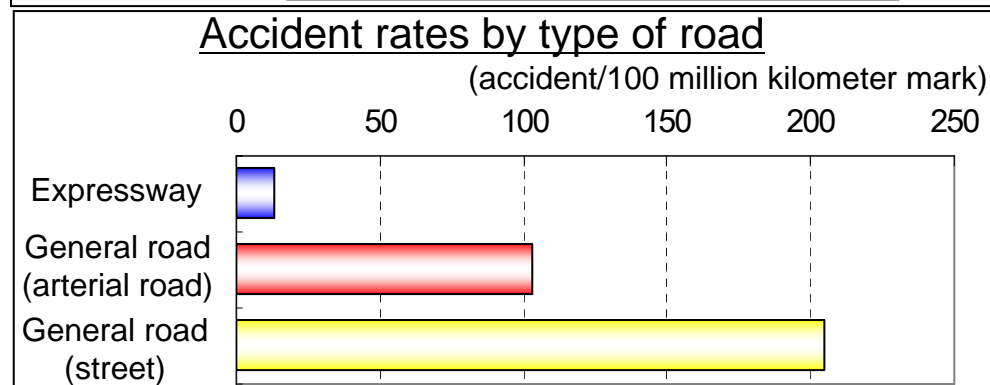
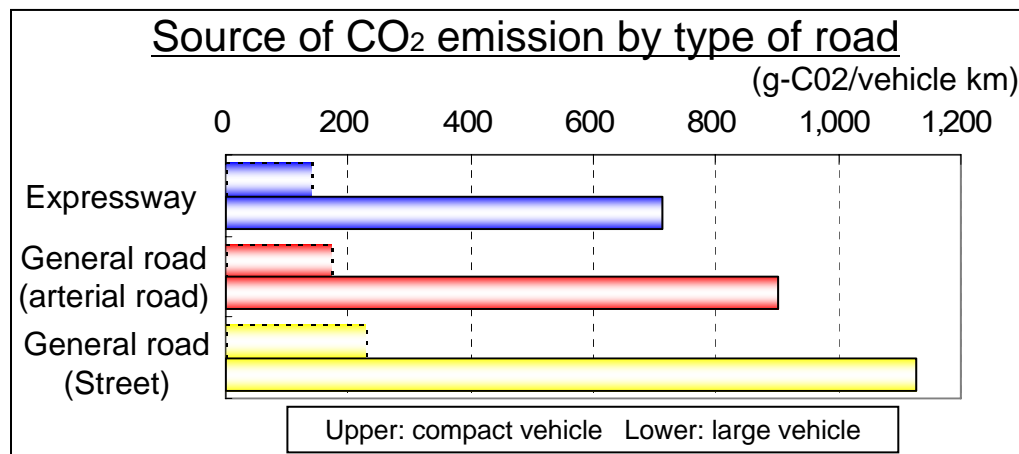
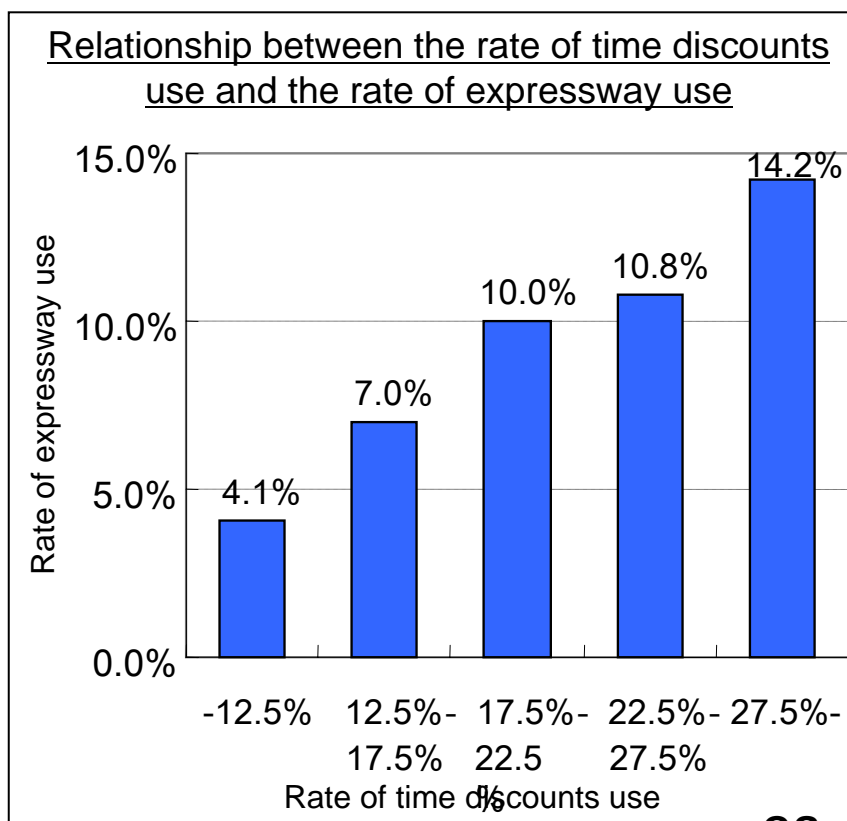
Diverse and flexible toll-charge systems in JAPAN

- Demonstration projects proposed by regional bodies
 - The national government and local governments establish a council consisted of regional public bodies.
 - This council plans and conducts demonstrations of tolls suited to each area.
 - The national government and local governments pay amounts to expressway companies to maintain toll road profitability.
- Time-period discount systems on expressways (only ETC-equipped cars)
 - Commuting discount in rural areas: 50% discount (6:00 to 9:00 am, 5:00 to 8:00 pm)
 - Early morning and nighttime discounts in metropolitan areas: 50% discount (10:00 pm to 6:00 am)
 - Late-night discounts throughout Japan: 30% discount (midnight to 4:00 am)

Effects of toll discount measures

- The more discounts are used, the more expressways are used.
- The rates of CO2 emissions and traffic accidents are lower on expressway than on general roads.

promoting expressway help reduce CO2 emissions and traffic accidents.





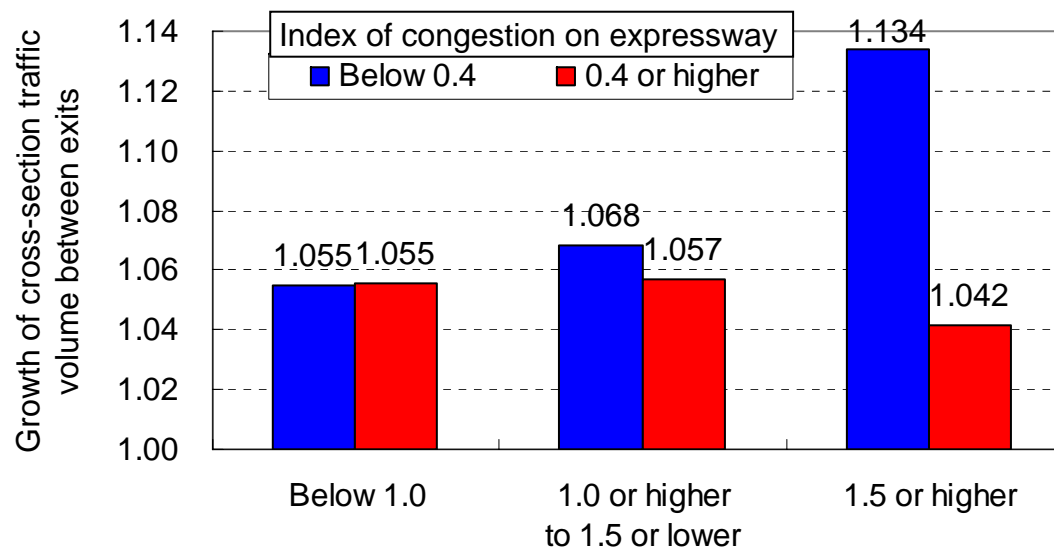
3. Analysis of trends in the effectiveness of toll discounts

Congestion trends

- The more congestion on general roads, the greater the change in traffic volume on expressways that are not congested.
- Regardless of the degree of congestion on general roads, there is little change in traffic volume on expressways that are congested.



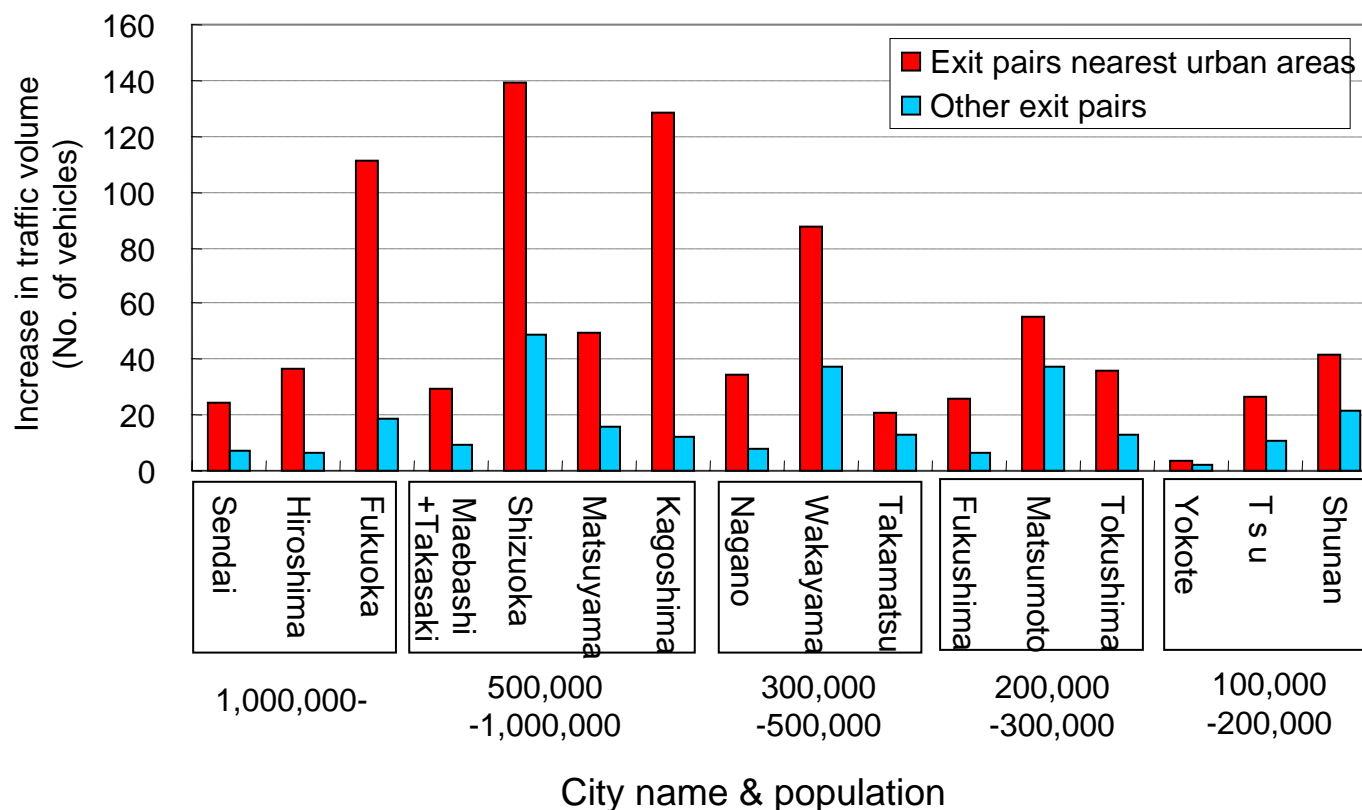
It is effective to implement toll discounts in sections where general roads are congested but expressways are not.



Index of congestion on general roads running parallel to expressways

Trends in urban area & population size

- Increase in traffic volume at exit pairs nearest urban areas is larger than at other exit pairs.
- A city's population does not impact on increase in traffic volume.

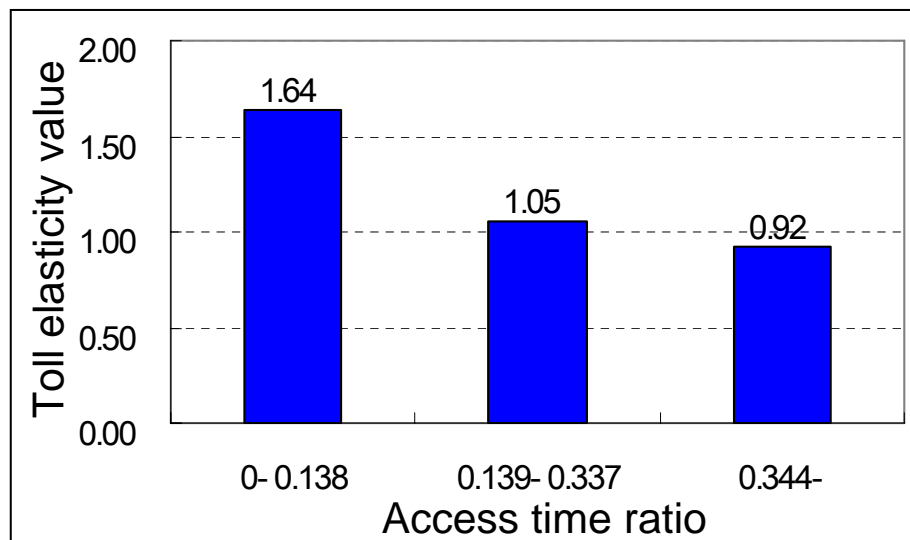
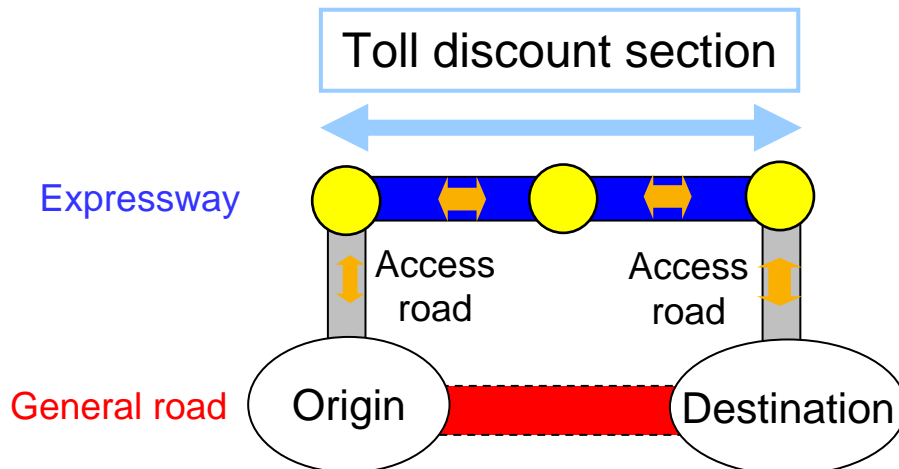


Accessibility trends

- The lower the access time ratio, the higher the toll elasticity value.
- ➡ **Good accessibility helps drivers switch to expressways.**

$$\text{Toll elasticity value} = -\frac{\Delta Q}{\Delta P} \quad \begin{array}{l} \Delta Q : \text{Change in traffic volume between before and after} \\ \Delta P : \text{Change in toll between before and after} \end{array}$$

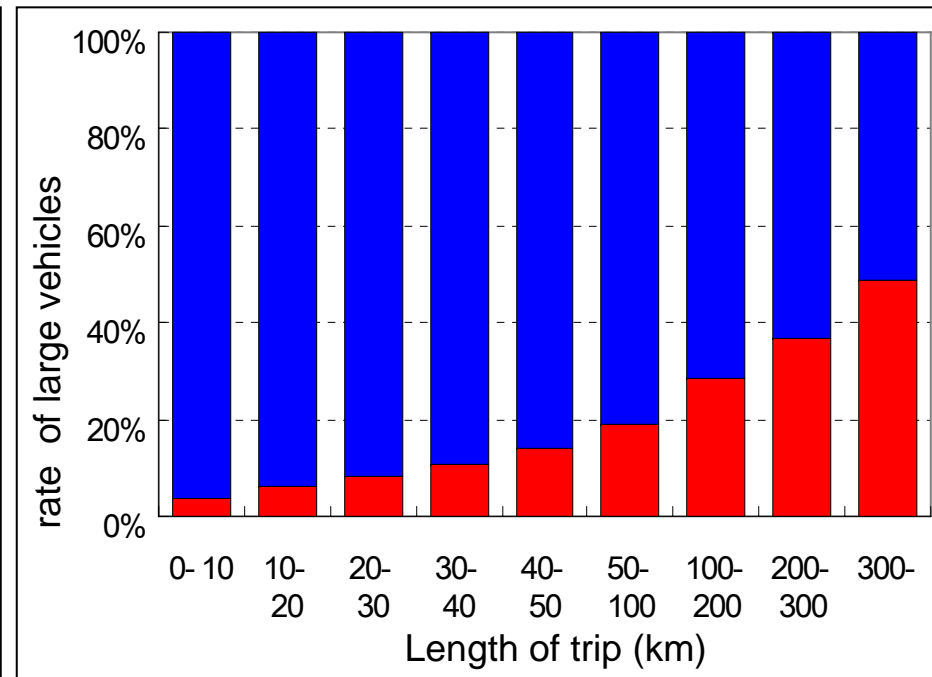
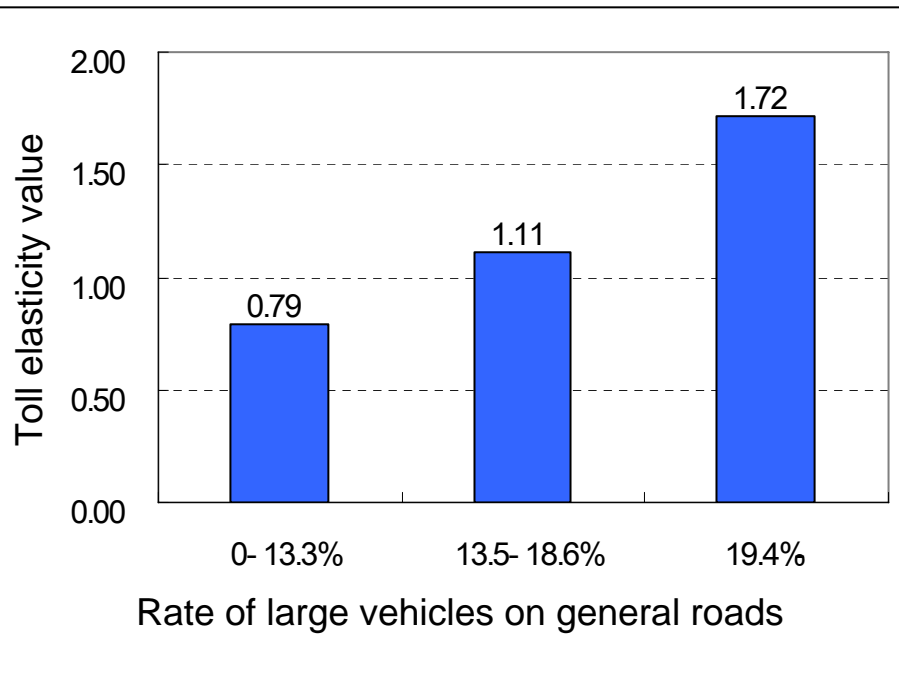
$$\text{Access time ratio} = \frac{\text{Travel time on access roads}}{\text{Total travel time}}$$



Trends in the rate of large vehicles

- The higher the rate of large vehicles on general roads, the higher the toll elasticity value.
- The longer the length of trip, the higher the rate of large vehicles.

➔ It is assumed that drivers on long trips tend to switch to expressways.



4. Conclusions

Conclusions of this study

- Toll discounts help to raise the rate of expressway use, and greater use of expressways reduces traffic accidents and CO₂ emissions.
- When expressways are not congested but general roads are congested, drivers tend to switch to the expressways.
- Exit pairs nearest urban areas have substantial increases in traffic volume when commuting discounts are available.
- When drivers can easily access expressways from general roads running parallel to them, they tend to switch to the expressways.
- When the rate of large vehicles on general roads is high, drivers tend to switch to the expressways.

Future plans

- New demonstration projects for toll discounts are being implemented in Japan.
 - Holiday discounts at traffic jam points on expressways (in metropolitan areas)
 - Early evening (3:00-5:00 pm) or daytime (9:00 am – 5:00 pm) discounts (in sections where general roads are congested in rural areas)
 - Ring-road discount (in metropolitan areas)
 - Expanded late-night (10:00 pm-midnight) discounts on a belt line (Tokyo-Nagoya-Osaka)

- Analysis of the effects and impacts of these projects.

- Proposal of more efficient & effective toll systems from next year.