

**“Technical Research and Development for Road Policy Quality Improvement”  
Study Summary**

No.	Title	Principal Researcher
No.22-○	Technical Research and Development for Estimating the Capital Stock of Road Infrastructure	Prof. Morito Tsutsumi, University of Tsukuba

Technical research and development for estimating the capital stock of road infrastructure at the municipality level, using the Physical Stock Value method in order to grasp the current situation and investment efficiency

### 1. Backgrounds and Objects

Even as infrastructure investment decreases on account of the severe financial limitations of governments, the need for examining the efficiency or inter-regional fairness of allocation of government investment for infrastructure is growing. A typical way to verify the economic efficiency of infrastructure investment is productivity analysis. However, productivity analysis has limitations in that the prefectural level is the most geographically detailed level, because the data of capital stock required for the analysis are provided at the prefecture level, not at the municipality level.

The objectives of this research and development effort are as follows: (1) to propose a new method for estimating the capital stock of road infrastructure, (2) to examine the method's applicability in order to contribute to the estimation of capital stock at the municipality level in Japan, and (3) to confirm the advantage(s) of the proposed method.

### 2. Activities in Research Period

**Table 1 Typical Methods for Estimating Capital Stock**

	PI (Perpetual Inventory) Method	BY (Benchmark Year) Method	PS (Physical Stock Value) Method
<b>Abstract</b>	Sum up annual real investment $K_t = \sum_{i=t-m+1}^t I_i$ $= K_{t-1} + I_t - I_{t-m}$ <i>K</i> : gross capital stock, <i>I</i> : gross investment, <i>t</i> : year of interest, <i>m</i> : average years of endurance	Add/subtract investment amount to/from estimate for the benchmark year $K_t = K_{t-1} + I_t - R_t$ $= K_b + \sum_{i=b+1}^t I_i - \sum_{i=b+1}^t R_i$ <i>K</i> : gross capital stock, <i>I</i> : gross investment, <i>R</i> : gross retirement, <i>t</i> : target year, <i>b</i> : base year	Multiply the amount of physical stock by unit price during the benchmark year and sum up $K_t = \sum_j (Q_{jt} \times P_{jt})$ <i>K</i> : gross capital stock, <i>Q<sub>jt</sub></i> : quantitative amount of goods <i>j</i> in year <i>t</i> , <i>P<sub>jt</sub></i> : unit price of goods <i>j</i> in year <i>t</i> , <i>t</i> : target year, <i>j</i> : goods category
<b>Issues</b>	Long-term investment data (spanning the whole lifetime) without gaps are required.	Estimated values for the benchmark year and investment data for other years are required.	It is very difficult to get detailed data pertaining to the physical stock and unit price.
<b>Example</b>	Japan: sectoral infrastructure. US, Canada: road and other infrastructure.	Several cases in Japan and South Korea.	Practically none.
<b>Remarks</b>	Expected to be applied at the proposal stage.		Applied in accordance with the comments at the screening stage.

Table 1 shows the typical method for estimating capital stock.

The applicability of the PS method was examined from the viewpoints of model building and estimation results, the goal being to develop a capital stock estimation model that reflects the conditions of road management (such as maintenance and renewal). A model based on the PS method was constructed and applied to the roads in Ibaraki Prefecture (Japan), and the estimated results were compared with those from the BY method. The Computable General Equilibrium (CGE) model was built and applied at the municipality level to cases where road infrastructure is supposed to be partially lost.

### 3. Study Results

Regarding the application of the BY method, using the ‘Road Statistics Annual Report’ of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), instead of the ‘Report on Administrative Investments’ of the Ministry of Internal Affairs and Communications (MIC), enabled us to distinguish new investments and repair investments and to apply the land cost suitable to the target area.

An actual condition survey allowed us to confirm that the data provided by the entities managing information on roads are not organized enough for us to estimate the capital stock.

On the other hand, we could successfully apply the PS method and use various data (listed in Table 2) for capital stock estimation, demonstrating the method’s applicability. We then empirically discussed the characteristics of the BY and PS methods.

Table 2 List of Data used for the Application of the PS Method

		National Highways under the MLIT’s Jurisdiction	Municipal Roads	Prefectural Roads and National Highways under Prefectural Jurisdiction
Physical Dimensions	Length	DRM	Road Ledger Record	DRM
	Width	DRM	Road Ledger Record	Road Ledger Record
	Bridge	MICHI	Bridge Ledger	Bridge Ledger
	Tunnel	—— (Out of scope for this study)	Tunnel Ledger	Tunnel Ledger
Year of Opening	Annual Report by the National Highway Office	Road Ledger Record	Road Ledger Record, Annual Report of Ibaraki Prefecture, Alignment Record	
Unit Price	Research Centre for PPP, Toyo University	Research Center for PPP, Toyo University, Tokyo Pref., MIC, NILIM	Research Centre for PPP, Toyo University, Tokyo Prefecture, MIC, NILIM	
Expected Lifetime	Nemoto (2011)	Ordinance of the FM, MIC	MIC	
Deflator	Construction Costs Deflator	Construction Costs Deflator	Construction Costs Deflator	

The study constructed and applied a Spatial Computable General Equilibrium (SCGE) model that can conduct a regional economic analysis at the municipality level. The model estimated the effect on the added value using the supposed partial loss of road infrastructure and negative benefit caused by the loss.

### 4. Papers for Presentation

Morito Tsutsumi, Kohei Yamaki, Akira Shimada: Trial for the Estimation of Road Capital Stock at the Municipality Level in Ibaraki Prefecture, Proceedings of Infrastructure Planning, Vol.47 (CD-ROM No.419), 2013.

Akihiko Ohara, Morito Tsutsumi, Akihiko Noda, Yoshiaki Kinugawa, Chino Arai: GIS-based supporting system for Public Facility Management, Proceedings of Infrastructure Planning, Vol.51 (CD-ROM No.135), 2013.

### 5. Study Development and Future Issues

Setting a unit price in the PS method has a profound effect on the estimates. However, setting the unit price and depreciation method according to the level of deterioration of the road continues to be problematic. Since the information for the PS method is not well-stored and the situation is not likely to improve soon, building a hybrid model combining the BY/PI method and the PS method could offer a solution. For the proper estimation of road capital stock, management of various data, such as actual traffic volume and maintenance costs, should be integrated in the Geographic Information System.