

Impact Evaluation of Infrastructure and Its Financing

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Economic Effect of Infrastructure Investment

- (1) Macroeconomics analysis**
- (2) Micro-data approach**

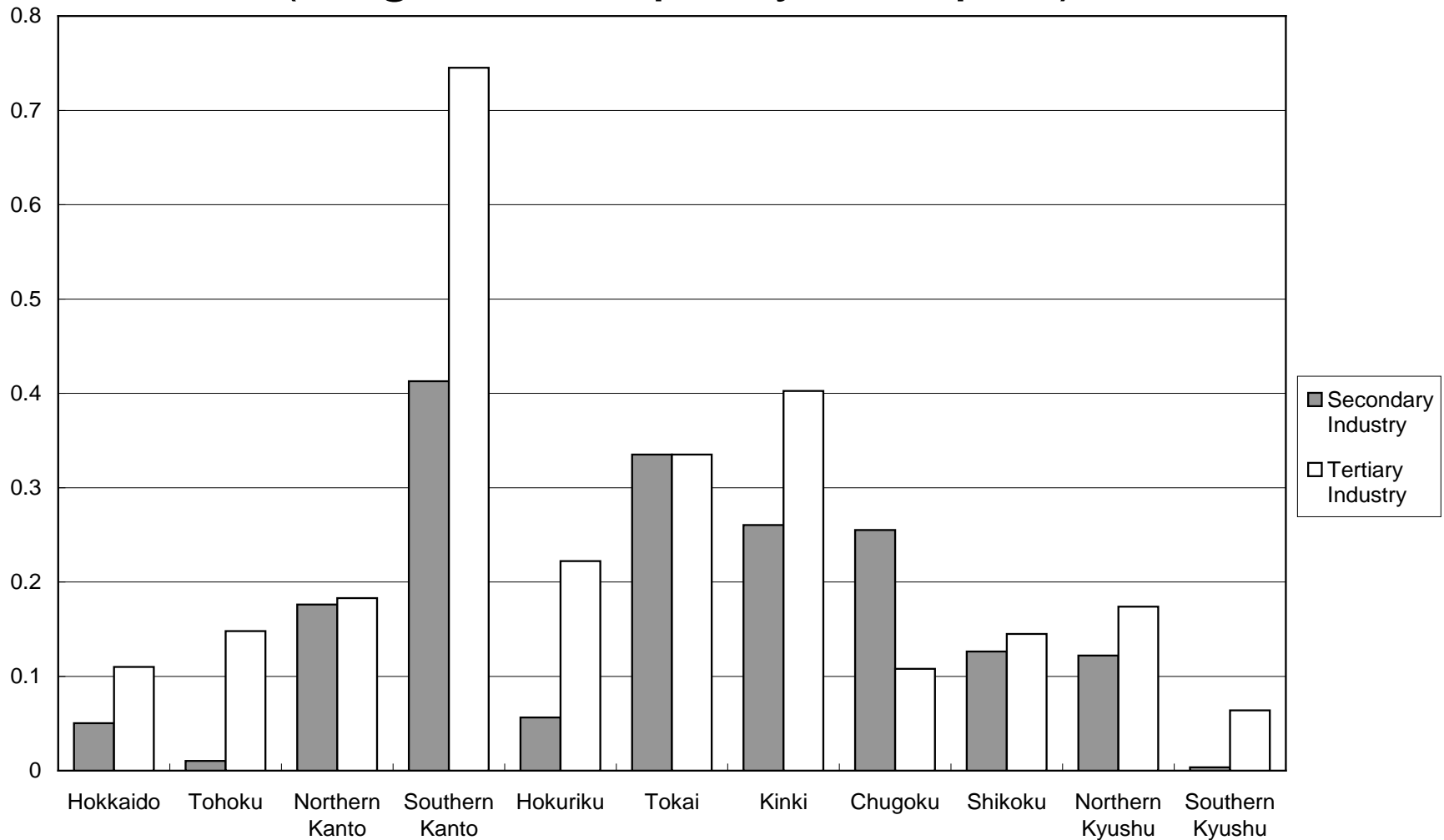
Sources of Finance for Infrastructure Investment

- (1) by tax payers' money;**
- (2) use of national savings (or postal savings);**
→ Financial Inclusion
- (3) issue bond to construct infrastructures;**
→ general obligation bond, project bond
- (4) Public-Private-Partnership**
→ Too much borrowing from overseas
might become the burden for the future.

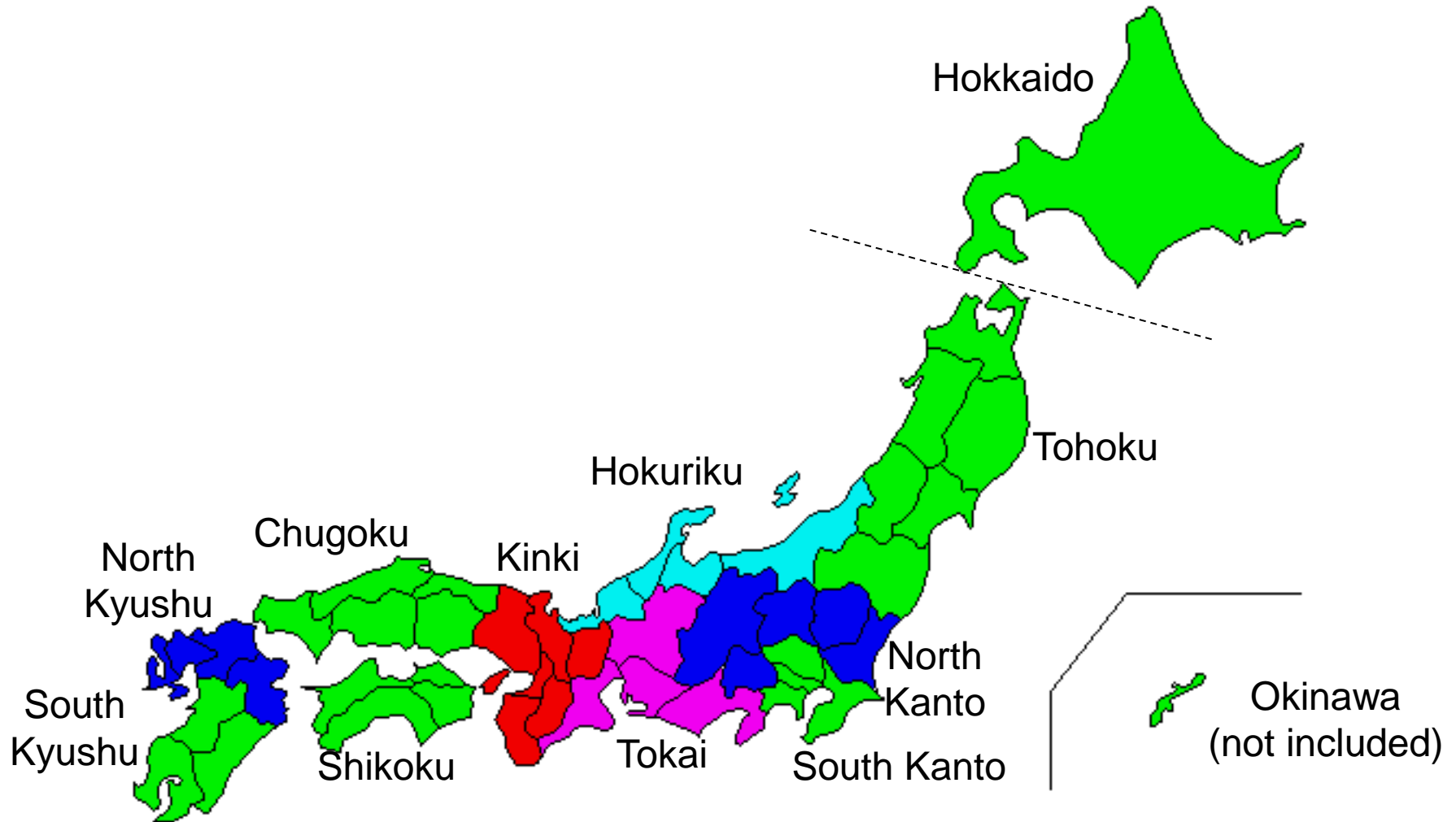
Which Method will induce better performance of infrastructure ?

Marginal Productivity of Public Capital

(Regional Disparity in Japan)



Map of Japan from the North to the South



Economic Effect of Public Capital

$$Y_t = f(Kp_t, L_t, Kg_t)$$

Simultaneous regression of

Translog Production Function and Labor Share Function

$$\ln Y = \alpha_0 + \alpha_1 \ln Kp + (1 - \alpha_1) \ln E + \alpha_3 \ln Kg$$

$$+ \ln Kp \left(-\frac{1}{2} \beta_2 \ln Kp + \beta_2 \ln E + \beta_3 \ln Kg \right)$$

$$+ \ln E \left(-\frac{1}{2} \beta_2 \ln E - \beta_3 \ln Kg \right) + \frac{1}{2} \beta_6 - (\ln Kg)^2$$

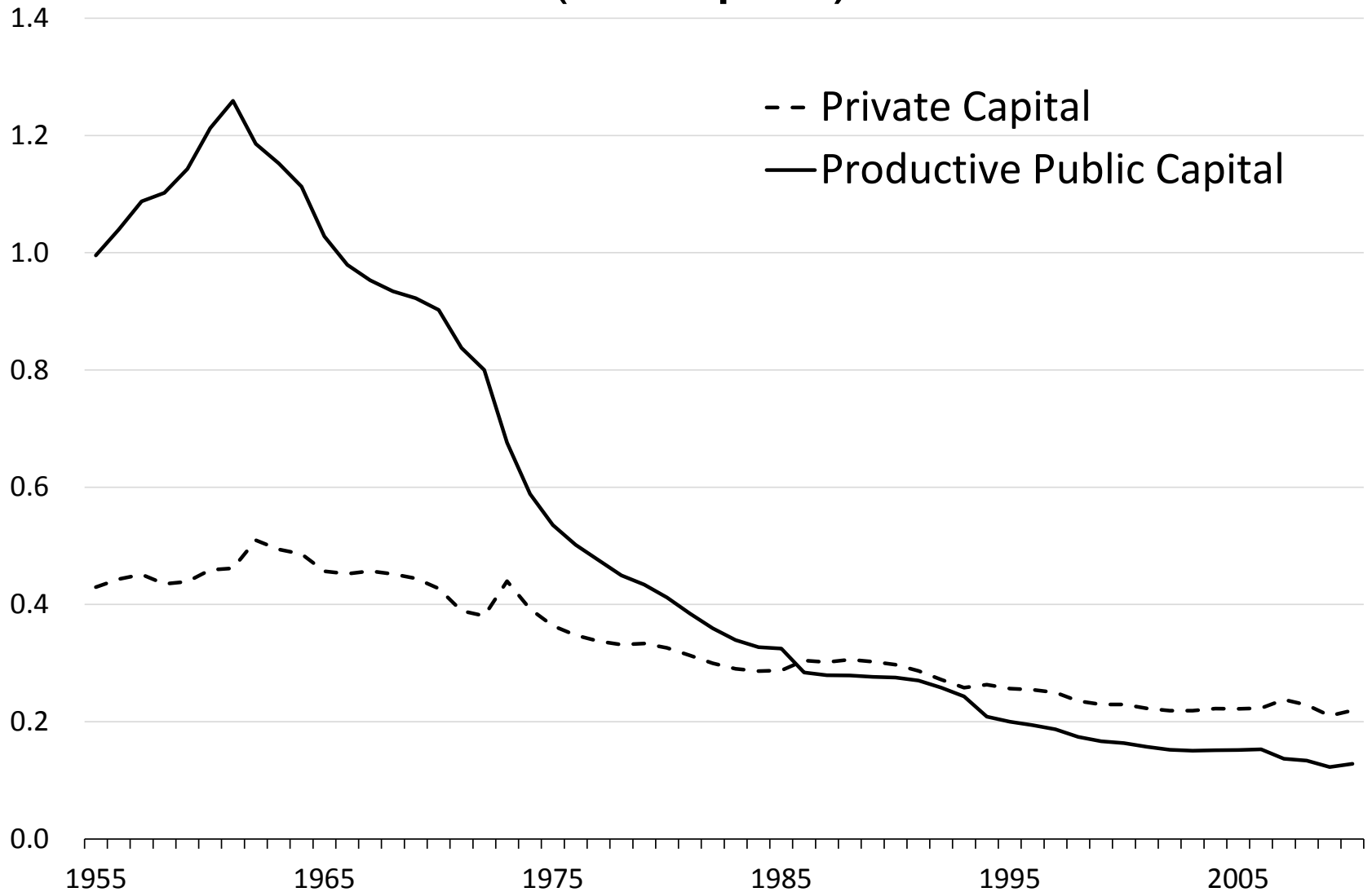
$$S_E = \frac{wE}{pY} = \frac{\partial \ln Y}{\partial \ln E} = (1 - \alpha_1) + \beta_2 \ln Kp - \beta_2 \ln E - \beta_3 \ln Kg$$

Marginal Productivity of Public Capital (in Japan)

Period(FY)	1956-60	1961-65	1966-70	1971-75	1976-80	1981-85
Direct Effect	0.696	0.737	0.638	0.508	0.359	0.275
Indirect Effect(Private Capital)	0.453	0.553	0.488	0.418	0.304	0.226
Indirect Effect(Labor Input)	1.071	0.907	0.740	0.580	0.407	0.317
Private Capital	0.444	0.485	0.452	0.363	0.294	0.262

Period(FY)	1986-90	1991-95	1996-00	2001-05	2006-10
Direct Effect	0.215	0.181	0.135	0.114	0.108
Indirect Effect(Private Capital)	0.195	0.162	0.122	0.100	0.100
Indirect Effect(Labor Input)	0.192	0.155	0.105	0.090	0.085
Private Capital	0.272	0.242	0.219	0.202	0.194

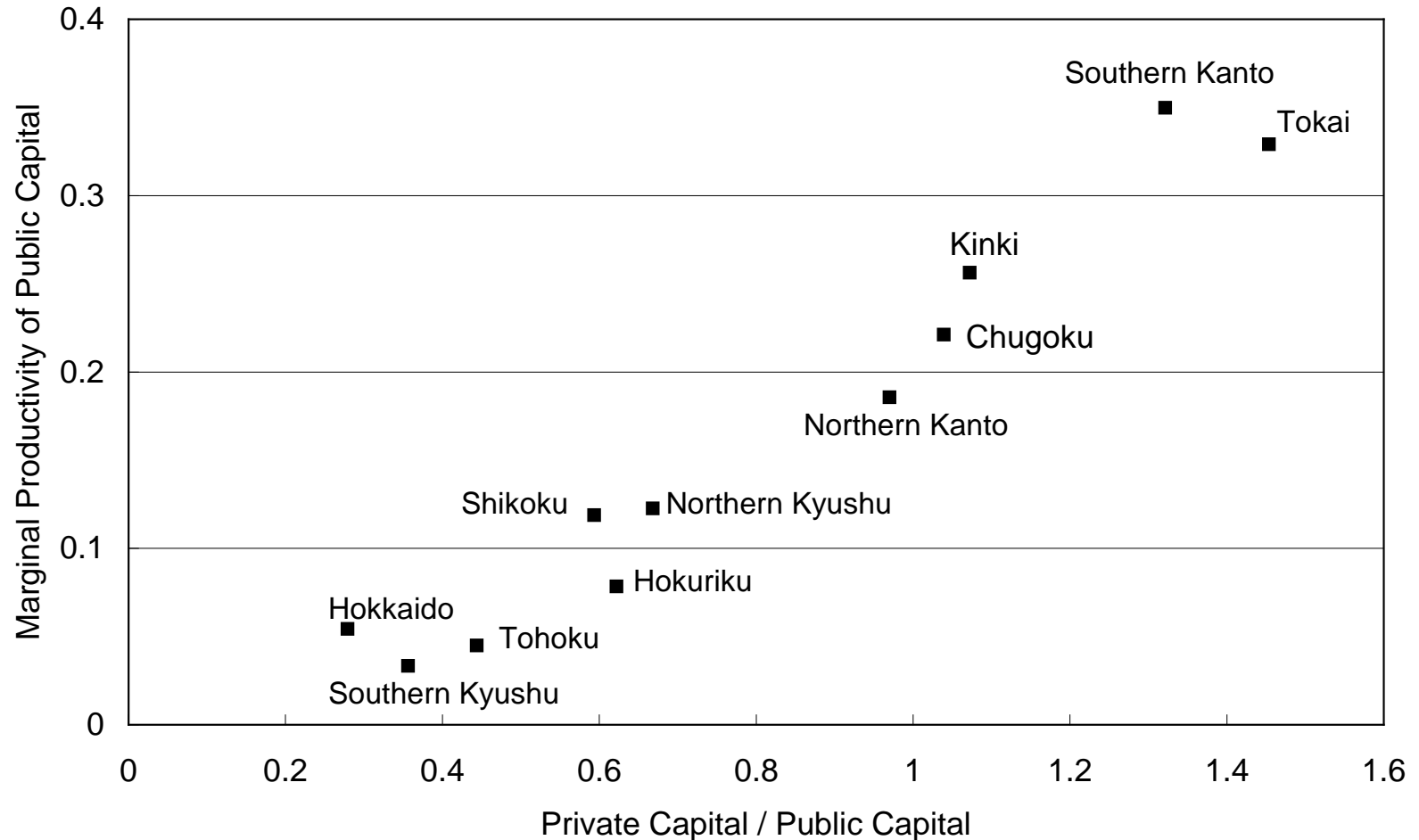
Changes in Productivity of Capital (in Japan)



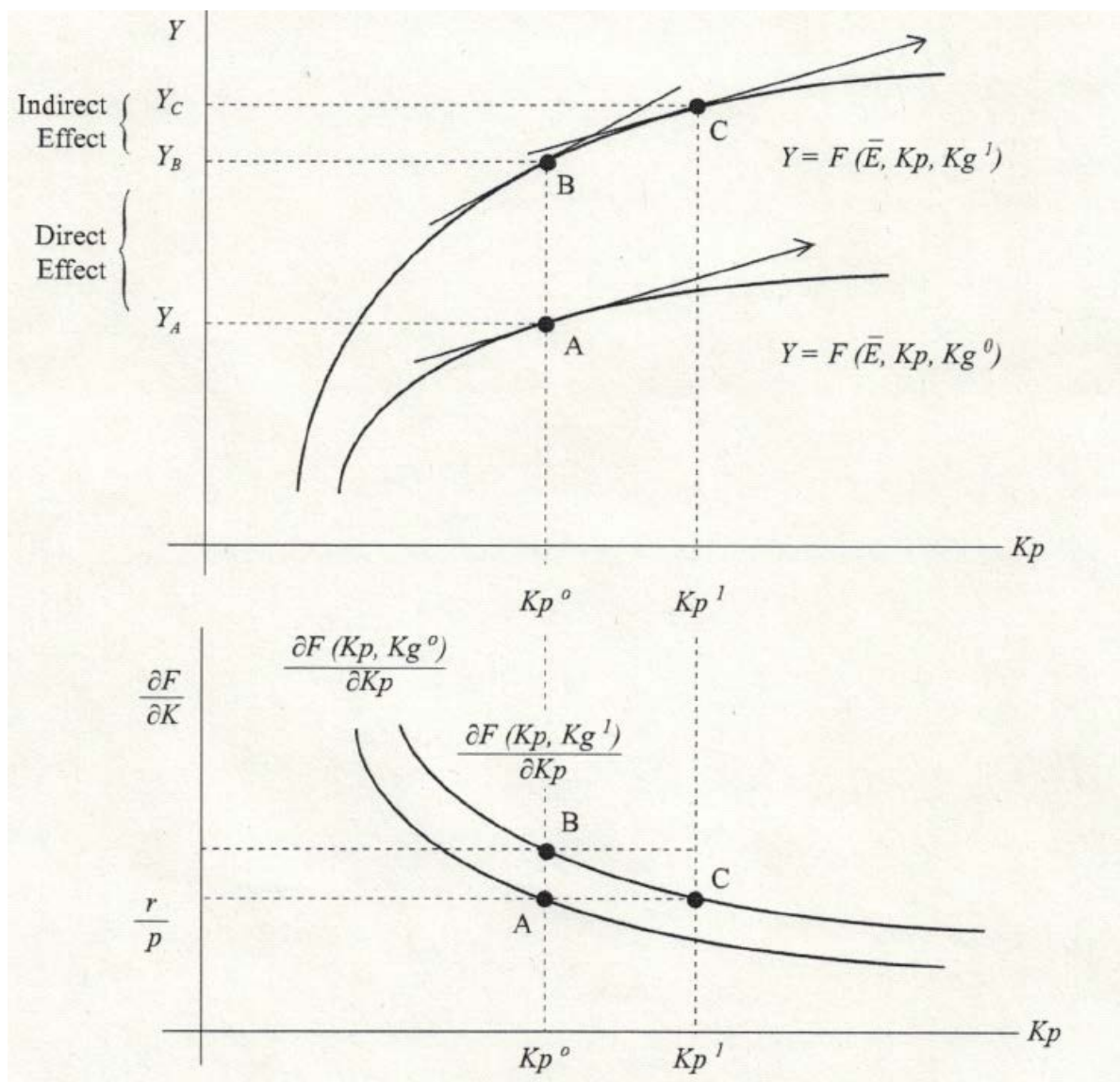
Effectiveness of Public Capital Stock

- “Private capital/Public capital ratio” to “Marginal productivity of Public capital” -

Secondary Industry (Industrial Sector)



Explanation of Direct and Indirect Effects



Micro Case Study - **Philippine micro data**

Objectives:

1, Evaluation of the 'highway effect' on tax and non-tax revenues using as case study the Southern Tagalog Arterial Road (STAR) in Batangas Province, Philippines

2, Evaluation is carried out using a quasi-experimental approach via a difference-in-difference (DiD) analysis

Case Study: Southern Tagalog Arterial Road (STAR)

- The Southern Tagalog Arterial Road (STAR) project in Batangas province, Philippines (south of Metro Manila) is a modified Built-Operate-Transfer (BOT) project.
- The 41.9 km STAR tollway was built to improve road linkage between Metro Manila and Batangas City, provide easy access to the Batangas International Port, and thereby accelerate industrial development in Batangas and nearby provinces.

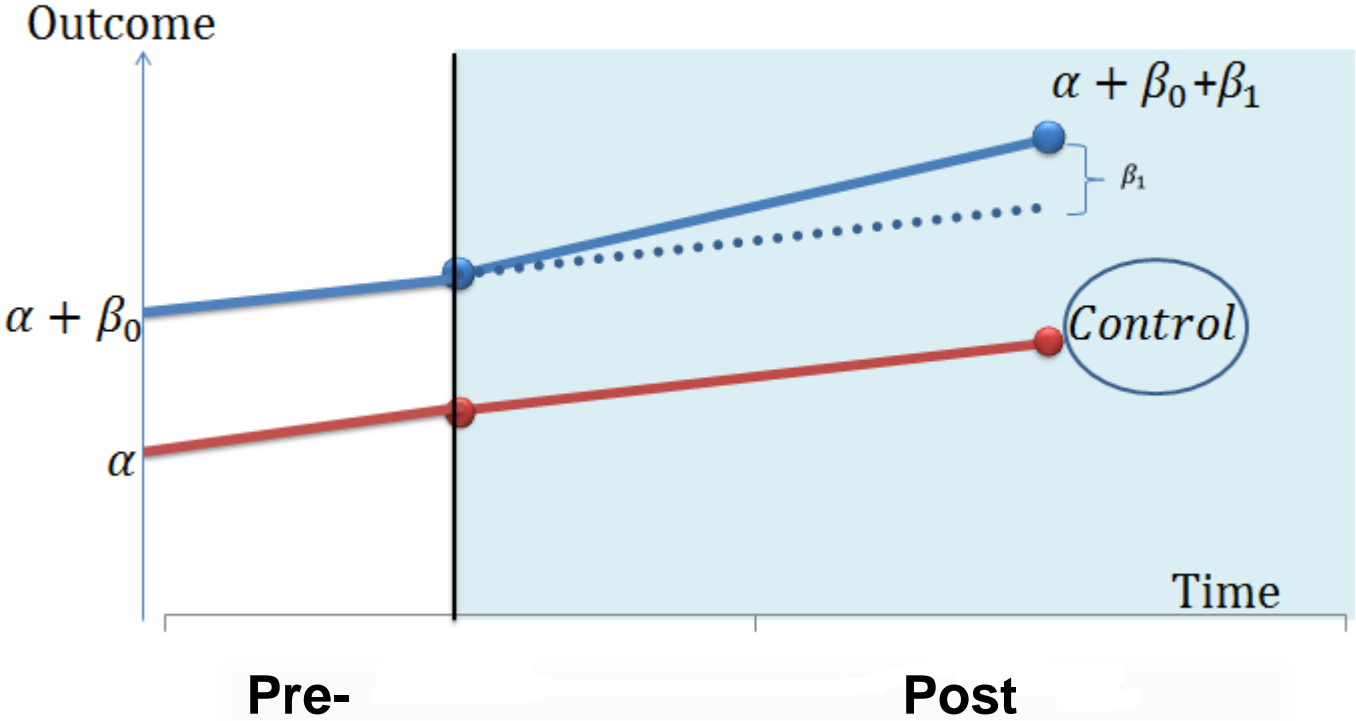


Case Study: Southern Tagalog Arterial Road (STAR)

- There are two stages in this project: STAR Tollway I is a 22.16 kilometer four-lane highway stretching from Santo Tomas, Batangas to Lipa City (Batangas province) and opened to traffic in **2001**
- STAR Tollway 2 is a 19.74 kilometer two-lane highway stretching from Lipa City to Batangas City and opened in **2008**



Method: Difference-in-Difference (DiD) Analysis



Method: Difference-in-Difference (DiD) Analysis

Outcome variable

- We employ data on **property tax revenues, business tax revenues, regulatory fees and user charges** of the cities and municipalities comprising Batangas Province, Philippines.
- The tax and non-tax revenues data were obtained from the Philippine Bureau of Local Government Finance (BLGF)

Treatment group (D = 1)

Treatment group:

Lipa City,
Ibaan and
Batangas City



Difference-in-Difference Regression: Control Group 1

	(1) Property tax	(2) Property tax	(3) Business tax	(4) Business tax	(5) Regulatory fees	(6) Regulatory fees	(7) User charge	(8) User charge
Treatment D	1.370 (1.473)	1.466 (1.478)	0.819 (0.869)	0.776 (0.885)	0.932 (0.763)	0.929 (0.779)	0.513 (1.012)	0.612 (1.125)
Treatment D × Period _{t+2}	0.210** (0.099)	0.095 (0.100)	1.570*** (0.502)	1.616** (0.626)	0.186 (0.121)	0.162 (0.118)	0.651*** (0.132)	0.453*** (0.105)
Treatment D × Period _{t+1}	0.210** (0.096)	0.254** (0.104)	1.689*** (0.517)	1.978*** (0.585)	0.507** (0.225)	0.610*** (0.191)	0.502*** (0.151)	0.330 (0.277)
Treatment D × Period _{t0}	0.342*** (0.125)	0.293** (0.126)	1.849*** (0.519)	1.995*** (0.616)	0.609** (0.292)	0.637** (0.253)	0.740*** (0.175)	0.553 (0.292)
Treatment D × Period _{t-1}	0.373*** (0.128)	0.060 (0.161)	1.799*** (0.536)	1.541** (0.803)	0.774* (0.475)	0.591 (0.458)	0.836*** (0.289)	0.604 (0.470)
Treatment D × Period _{t-2}	0.471** (0.203)	0.183 (0.210)	1.739*** (0.589)	1.520* (0.831)	0.949** (0.430)	0.786* (0.412)	0.803*** (0.267)	0.576 (0.442)
Treatment D × Period _{t-3}	0.376*** (0.123)	0.136 (0.144)	1.968*** (0.479)	1.821** (0.692)	1.162*** (0.290)	1.037*** (0.282)	1.023*** (0.275)	0.804* (0.424)
Treatment D × Period _{t-4,} forward	1.247*** (0.344)	0.939*** (0.348)	2.610*** (0.280)	2.360*** (0.556)	1.548*** (0.231)	1.369*** (0.272)	1.321*** (0.456)	1.090* (0.603)
Construction		0.709** (0.278)		1.085 (0.920)		0.567 (0.399)		0.118 (0.580)
Constant	16.18*** (0.504)	10.34*** (2.45)	15.25*** (0.516)	6.290 (8.038)	14.84*** (0.272)	10.19*** (3.13)	14.26*** (0.265)	13.39*** (4.85)
N	98	90	98	90	98	90	97	90
R ²	0.24	0.25	0.36	0.37	0.42	0.42	0.20	0.21

Clustered standard errors, corrected for small number of clusters; * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Treatment and Control group - Spillover effect

Treatment group:

Lipa City,
Ibaan and
Batangas City

Control group:

*(municipalities
belonging to
neighboring
Quezon
province)*

Candelaria
Dolores
San Antonio
Tiaong



Difference-in-Difference Regression: Spillover

	(1) Property tax	(2) Property tax	(3) Business tax	(4) Business tax	(5) Regulatory fees	(6) Regulatory fees	(7) User charge	(8) User charge
Treatment D	1.5535 (1.263)	0.736 (0.874)	1.067 (1.316)	0.438 (1.407)	1.372 (1.123)	0.924 (1.046)	0.990 (1.095)	0.364 (1.028)
Treatment D × Period _{t+2}	0.421** (0.150)	-0.083 (0.301)	1.189*** (0.391)	0.991** (0.450)	0.248*** (0.084)	-0.019 (0.248)	0.408*** (0.132)	-0.010 (0.250)
Treatment D × Period _{t+1}	0.447** (0.160)	0.574*** (0.118)	1.264*** (0.415)	1.502*** (0.542)	0.449** (0.142)	0.515*** (0.169)	0.317** (0.164)	0.434** (0.167)
Treatment D × Period _{t0}	0.497*** (0.128)	0.570** (0.223)	1.440*** (0.417)	1.641*** (0.482)	0.604** (0.183)	0.642*** (0.181)	0.350 (0.271)	0.422 (0.158)
Treatment D × Period _{t-1}	1.294** (0.674)	0.387 (0.728)	2.256** (0.957)	1.779** (0.470)	1.318** (0.649)	0.838* (0.448)	0.959 (0.714)	0.197 (0.560)
Treatment D × Period _{t-2}	1.163* (0.645)	0.336 (0.594)	2.226** (0.971)	1.804** (0.531)	1.482** (0.634)	1.044** (0.413)	0.941 (0.704)	0.247 (0.531)
Treatment D × Period _{t-3}	1.702* (0.980)	0.450 (0.578)	2.785** (1.081)	2.070*** (0.544)	1.901*** (0.630)	1.238*** (0.369)	1.732*** (0.598)	0.676 (0.515)
Treatment D × Period _{t-4} forward	2.573*** (0.900)	1.100 (0.758)	3.428*** (0.928)	2.560*** (0.350)	2.288*** (0.563)	1.509*** (0.452)	2.030*** (0.607)	0.787 (0.745)
Construction		2.283** (1.172)		1.577 (1.196)		1.207 (0.855)		1.942* (1.028)
Constant	14.69*** (0.408)	-2.499 (8.839)	14.18*** (0.991)	2.230 (9.094)	13.66*** (0.879)	4.597 (6.566)	13.08*** (0.649)	-1.612 (7.84)
<i>N</i>	80	73	79	73	80	73	77	73
<i>R</i> ²	0.29	0.41	0.37	0.44	0.43	0.50	0.26	0.39

Clustered standard errors, corrected for small number of clusters; * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Scheme of Uzbekistan Railways

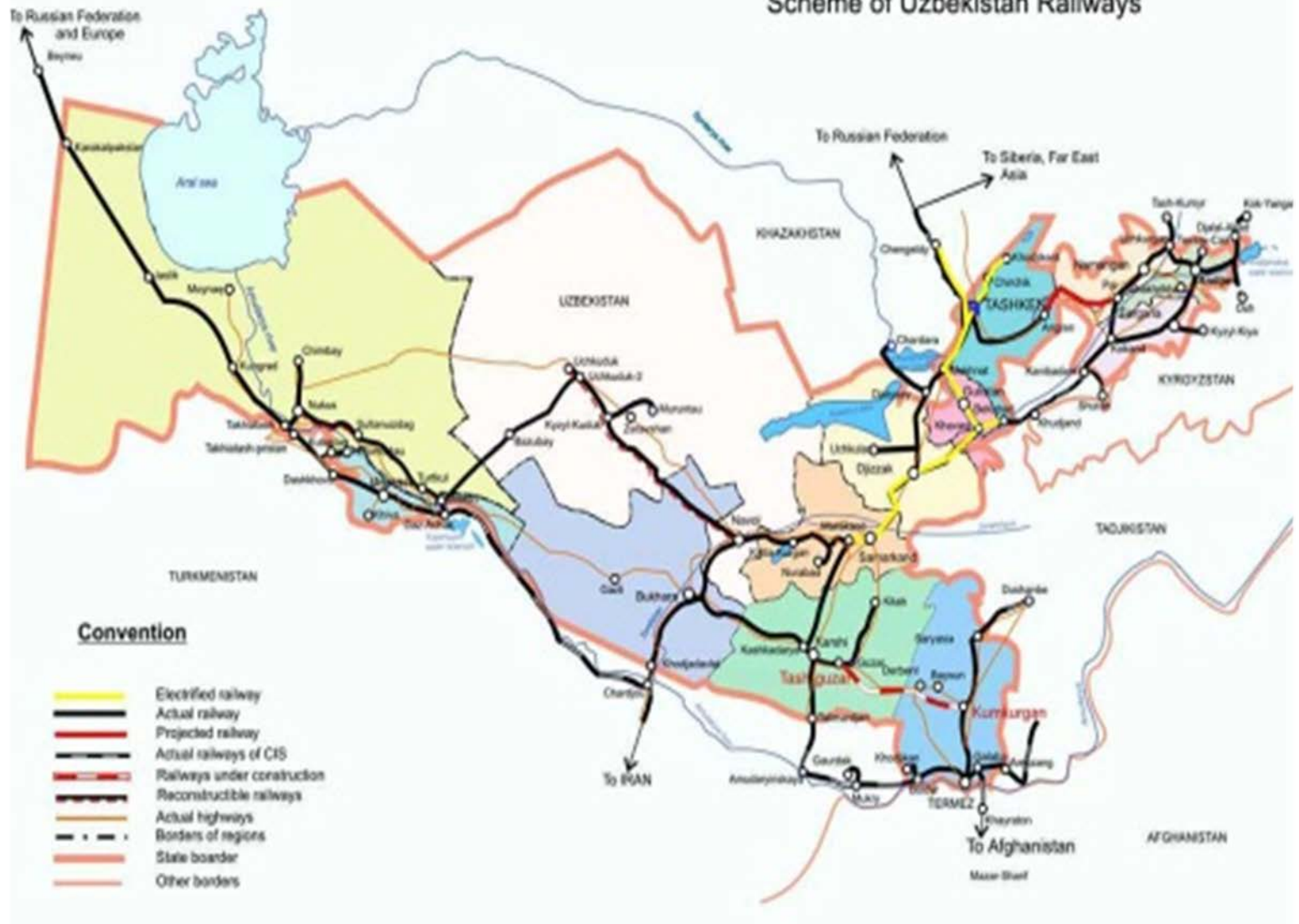


Table 1: Numerical estimation of difference in difference coefficient using regional data of Uzbekistan for periods 2005:2008 and 2009:2012

Regions	Outcome	Pre-railway	Post-railway period	Difference
Non-affected group	GDP growth rate	8.3	8.5	0.2
Affected Group	GDP growth rate	7.2	9.4	2.2
				2.0

GDP



	GDP	Term	Connectivity effect	Regional effect	Spillover effect	
1 year	Launching Effects	Short	2.83***[4.48]	0.70[0.45]	1.33[1.14]	
		Mid	2.5***[6.88]	0.36[0.29]	1.27[1.46]	
		Long	2.06***[3.04]	-0.42[-0.29]	2.29**[2.94]	
	Anticipated	Short	0.19[0.33]	0.85[1.75]	-0.18[-0.20]	
		Mid	0.31[0.51]	0.64[1.30]	-0.02[-0.03]	
		Long	0.07[0.13]	-0.006[-0.01]	0.50[0.67]	
	Postponed Effects			1.76*[1.95]	-1.49[-0.72]	2.58*[2.03]
	2 years	Anticipated	Short	-1.54[-1.66]	1.42[0.78]	-1.32[-0.92]
			Mid	0.32[0.44]	0.84[1.42]	0.13[0.13]
Long			0.11[0.15]	0.10[0.16]	0.87[1.19]	
Postponed Effects			-0.14[-0.20]	-1.71[-1.35]	1.05[1.44]	

Note: t-values are in parenthesis. t-value measures how many standard errors the coefficient is away from zero.

legend: * p<.1; ** p<.05; *** p<.01

To Create Incentive Mechanism

To Avoid Moral Hazard Problem

	Normal Case	Revenue Bond
Normal Case	(50A, r) Management Investors company	(50A, 100B)
Revenue Bond	(100A, r)	(100A, 100B) Management Investors Company

Public Private Partnership (PPP)

- (1) **Risk sharing** between private and public sector
- (2) Incentive cut costs and to increase revenue
 - Avoid political intervention
 - **Bonus payment for employees who run infrastructure**
- (3) Many projects could be started by PPP
 - **Utilize domestic savings**
 - life insurance and Pension funds (**long term**)
- (4) **Indirect Effects are important (tourism, manufacturing, agriculture, services)**