Economic Effects of Infrastructure and Governance of Infrastructure

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Knowledge Partnership
Joint partnership

1, Academic Research

theoretical analysis sometimes no reality

Lectures by ADBI staffs

2, ADB--- Operation Department

Country offices of ADB

3, Combination of 1 and 2

4, Policy proposals based on the facts, research

5, Knowledge Partnership

Professors and Graduate students

Research Topics

1, Central-Local government relations

2, Urban Housing policy

3, Infrastructure investment and governance

4, Obesity and Health Issues

5, Promotion of SMEs and SME finance

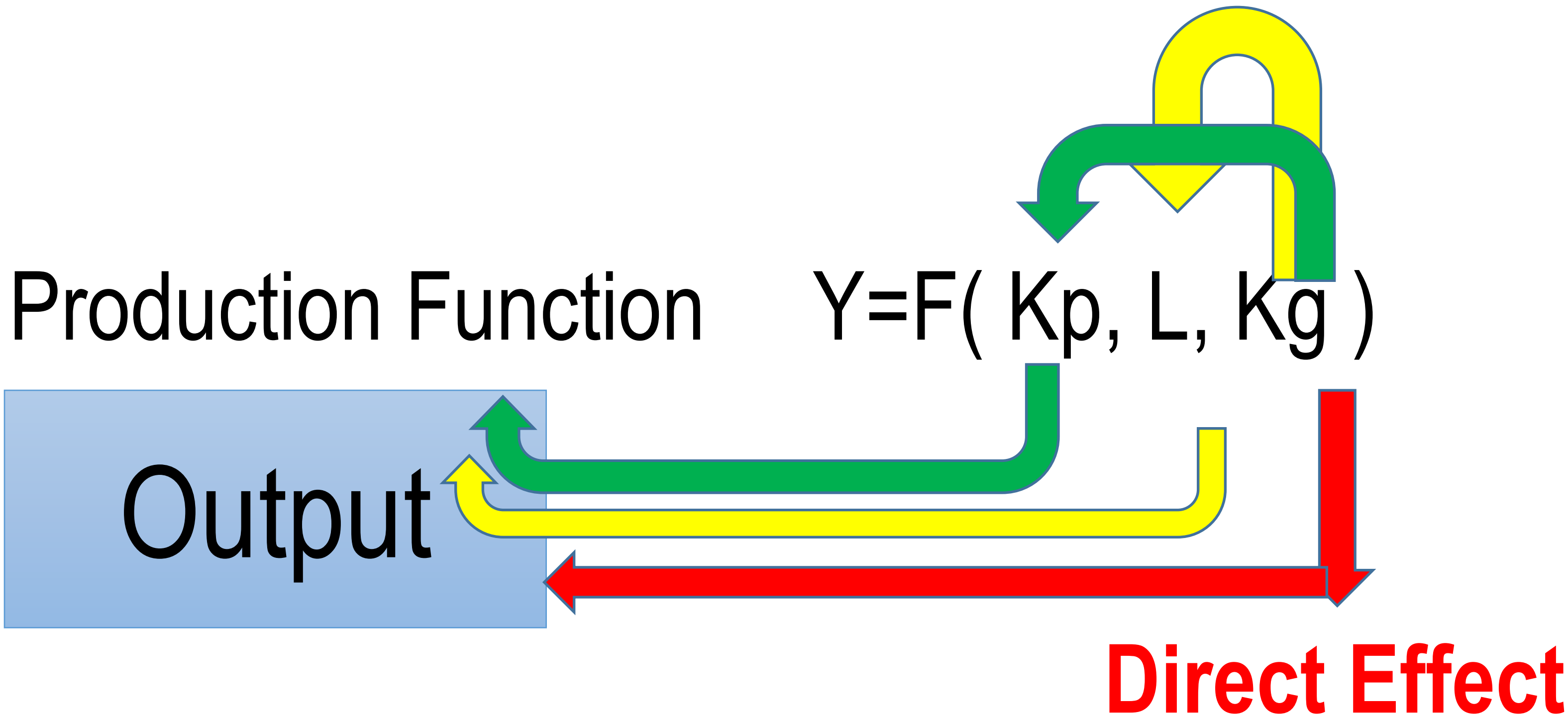
6, Income disctirution and tax system

7, Environmental Finance

8, Financial education and financial inclusion

9, Sustainability of Budget

Direct Effect and Spill-over Effects



Y= Output, Kp= private capital, L = labor

Kg = public capital (infrastructure)

Return the spillover effects to Investors

The production technology of the private sector is represented by the following production function.

$$Y = f(K_P, L, K_G) \tag{1}$$

where Y denotes output (in value added) in the private sector. The output is produced by combining private capital stock, Kp, labor input, L, and infrastructure stock, K_G.

In this paper, we assume the translog production function.

$$\begin{aligned} \ln Y = {} & \alpha_0 + \alpha_K \ln K_P + \alpha_L \ln L + \alpha_G \ln K_G \\ & + \beta_{KK}(1/2)(\ln K_P)^2 + \beta_{KL} \ln K_P \ln L + \beta_{KG} \ln K_P \ln K_G \\ & + \beta_{LL}(1/2)(\ln L)^2 + \beta_{LG} \ln L \ln K_G + \beta_{GG}(1/2)(\ln K_G)^2 \end{aligned} \tag{2}$$

Assuming the production function represented by equation (1), and that factor prices and infrastructure are given for producers in the private sector, the effect of infrastructure on productivity is expressed as:

$$\frac{dY}{dK_G} = \frac{\partial Y}{\partial K_G} + \frac{\partial Y}{\partial K_P}\frac{\partial K_P}{\partial K_G} + \frac{\partial Y}{\partial L}\frac{\partial L}{\partial K_G} \tag{9}$$

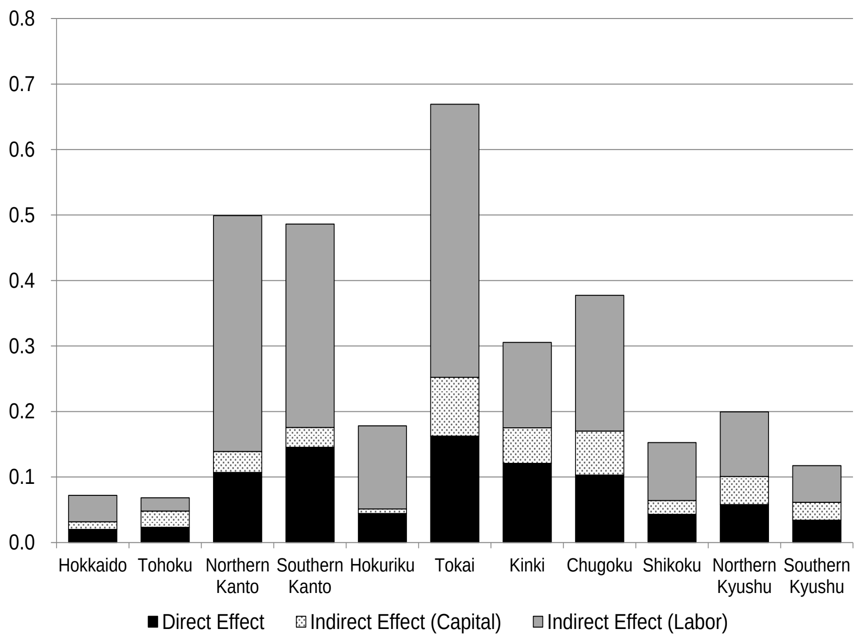
Here, the effect of infrastructure is divided into three parts; the first term on the right hand side of equation (9) represents *direct effect;* the second term is the *indirect effect* on output with respect to the resulting change in the input of private capital and the third term is the *indirect effect* on output with respect to the resulting effect on labor input.

Regional Disparities of Economic Effects

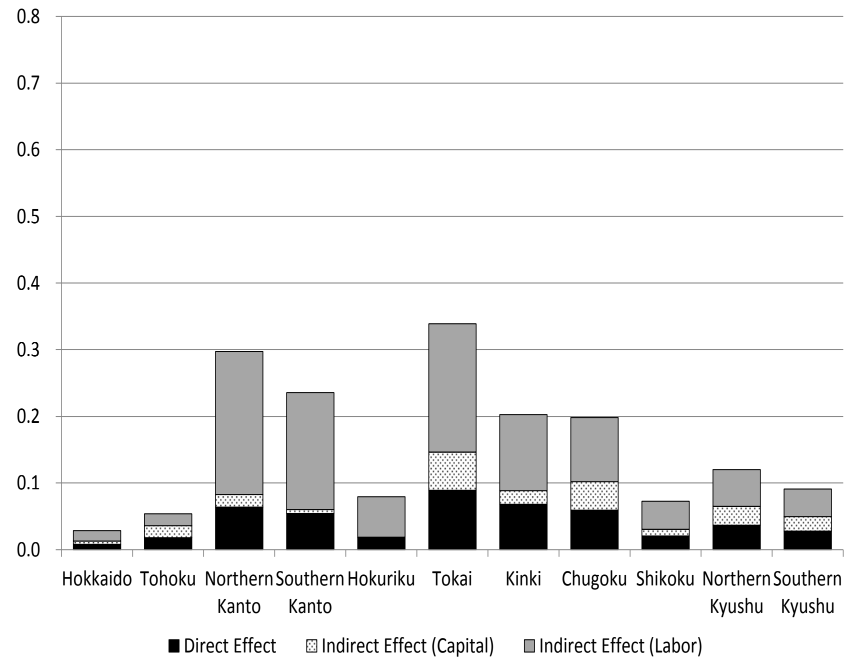
large differences in Spillover effects

Not many bankable projects in infrastructure

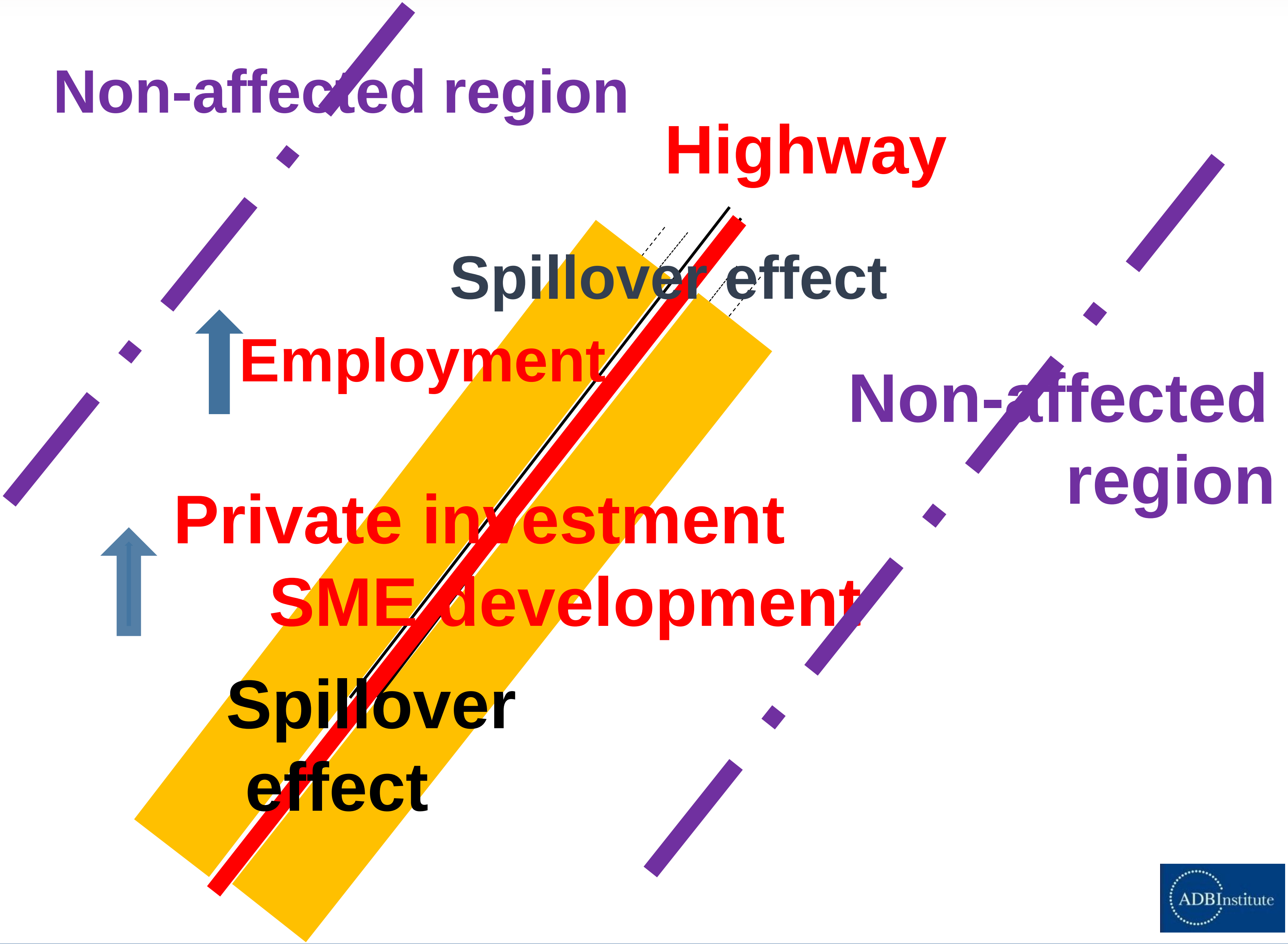
1990



2010

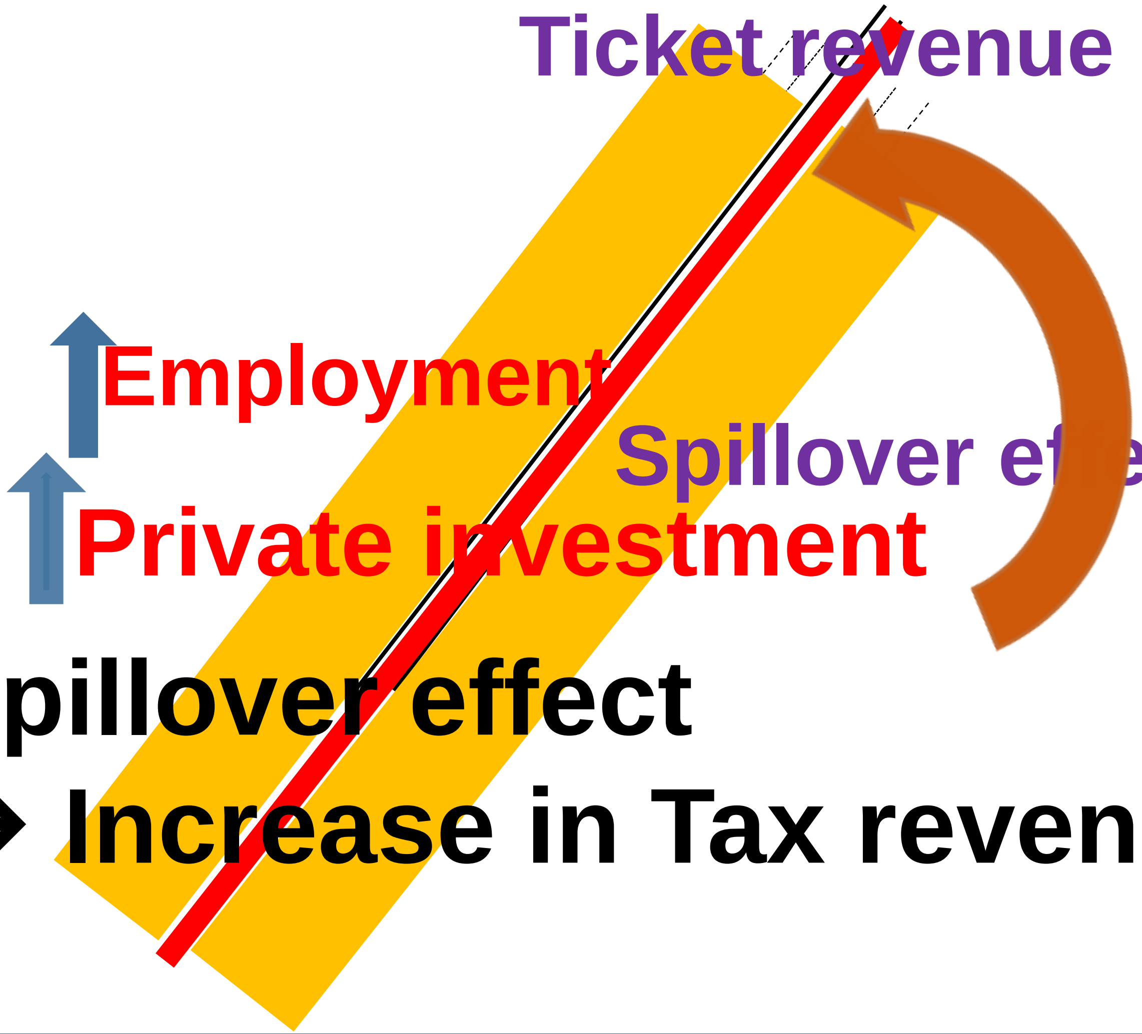


2010 Manufacturing	Private Capital	Public Capital	Direct Effect	Indirect Effect		20% Returned	Increment (%)
				Capital	Labor		
Hokkaido	0.084	0.028	0.008	0.005	0.016	0.004	50.8
Tohoku	0.111	0.054	0.018	0.018	0.018	0.007	40.0
Northern Kanto	0.068	0.297	0.064	0.019	0.215	0.047	73.2
Southern Kanto	0.052	0.235	0.054	0.006	0.175	0.036	66.5
Hokuriku	0.077	0.079	0.018	0.001	0.061	0.012	69.1
Tokai	0.093	0.339	0.089	0.057	0.192	0.050	55.9
Kinki	0.056	0.202	0.068	0.020	0.114	0.027	39.5
Chugoku	0.075	0.198	0.059	0.043	0.096	0.028	47.0
Shikoku	0.089	0.073	0.021	0.010	0.042	0.010	50.8
Northern Kyushu	0.093	0.120	0.037	0.028	0.055	0.017	45.5
Southern Kyushu	0.098	0.091	0.028	0.022	0.041	0.013	45.7


Non-affected region
Highway
Spillover effect
Employment
Non-affected region
Private investment
SME development
Spillover effect

Fees + Additional return from tax revenues

→Increase rate of return on investment



Spillover effect

→ Increase in Tax revenues

Spillover effects → Return to investors

	1956-60	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001–05	2006-10
Direct Effect (Kg)	0.696	0.737	0.638	0.508	0.359	0.275	0.215	0.181	0.135	0.114	0.108
Indirect Effect (Kp)	0.453	0.553	0.488	0.418	0.304	0.226	0.195	0.162	0.122	0.1	0.1
Indirect Effect (L)	1.071	0.907	0.740	0.580	0.407	0.317	0.193	0.155	0.105	0.09	0.085
20% Returned	0.3048	0.292	0.2456	0.1996	0.1422	0.1086	0.0776	0.0634	0.0454	0.038	0.037
%Increment	43.8	39.6	38.5	39.3	39.6	39.5	36.1	35.0	33.6	33.3	34.3

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Case Study: Southern Tagalog Arterial Road (STAR) , Philippineses Micro-data

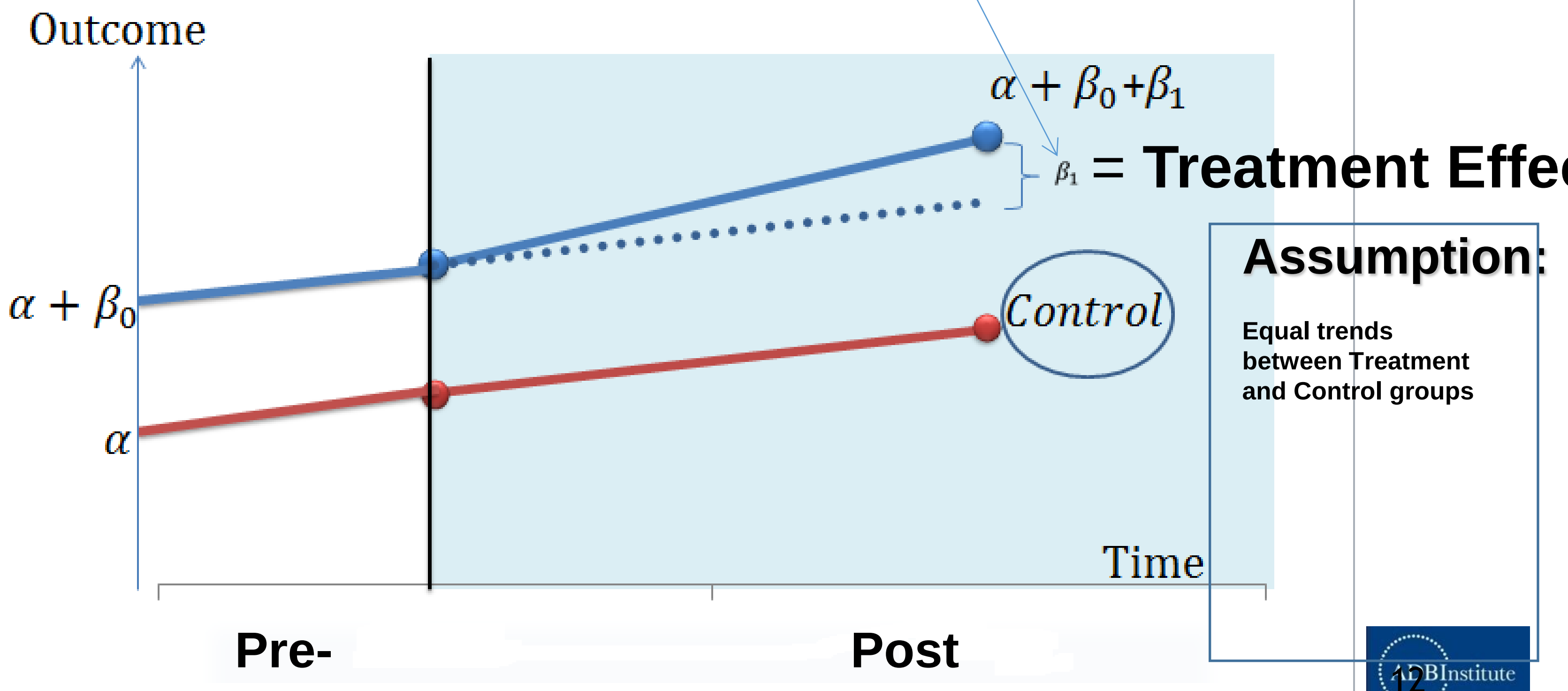
- The Southern Tagalog Arterial Road (STAR) project in Batangas province, Philippines (south of Metro Manila) is a modified Built-Operate-Transfer (BOT) project.

- 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.

Difference-in-Difference (DiD) Analysis

$$\text{Outcome} = \alpha + \beta_0 D + \sum_{t+2}^{t-4} \beta_1 D \times T + \varepsilon$$

where: D = 1 (Treatment group) T = Treatment period
D = 0 (Control group)



Assumption:

Equal trends between Treatment and Control groups

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	1.55535	0.736	1.067	0.438	1.372	0.924	0.990	0.364
	(1.263)	(0.874)	(1.316)	(1.407)	(1.123)	(1.046)	(1.095)	(1.028)
Treatment D × $Period_{t+2}$	0.421**	-0.083	1.189***	0.991**	0.248***	-0.019	0.408***	-0.010
	(0.150)	(0.301)	(0.391)	(0.450)	(0.084)	(0.248)	(0.132)	(0.250)
Treatment D × $Period_{t+1}$	0.447**	0.574***	1.264***	1.502***	0.449**	0.515***	0.317**	0.434**
	(0.160)	(0.118)	(0.415)	(0.542)	(0.142)	(0.169)	(0.164)	(0.167)
Treatment D × $Period_{t0}$	0.497***	0.570**	1.440***	1.641***	0.604**	0.642***	0.350	0.422
	(0.128)	(0.223)	(0.417)	(0.482)	(0.183)	(0.181)	(0.271)	(0.158)
Treatment D × $Period_{t-1}$	1.294**	0.387	2.256**	1.779**	1.318**	0.838*	0.959	0.197
	(0.674)	(0.728)	(0.957)	(0.470)	(0.649)	(0.448)	(0.714)	(0.560)
Treatment D × $Period_{t-2}$	1.163*	0.336	2.226**	1.804**	1.482**	1.044**	0.941	0.247
	(0.645)	(0.594)	(0.971)	(0.531)	(0.634)	(0.413)	(0.704)	(0.531)
Treatment D × $Period_{t-3}$	1.702*	0.450	2.785**	2.070***	1.901***	1.238***	1.732***	0.676
	(0.980)	(0.578)	(1.081)	(0.544)	(0.630)	(0.369)	(0.598)	(0.515)
Treatment D × $Period_{t-4, forward}$	2.573***	1.100	3.428***	2.560***	2.288***	1.509***	2.030***	0.787
	(0.900)	(0.758)	(0.928)	(0.350)	(0.563)	(0.452)	(0.607)	(0.745)
Construction		2.283**		1.577		1.207		1.942*
		(1.172)		(1.196)		(0.855)		(1.028)
Constant	14.69***	-2.499	14.18***	2.230	13.66***	4.597	13.08***	-1.612
	(0.408)	(8.839)	(0.991)	(9.094)	(0.879)	(6.566)	(0.649)	(7.84)
N	80	73	79	73	80	73	77	73
R^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%.

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The Southern Tagalog Arterial Road (STAR Highway), Philippines, Manila

Tax Revenues in three cities

Yoshino and Pontines (2015) ADBI Discussion paper 549

表 8　フィリピンの STAR 高速道路の影響のない地域と比較した事業税の増加額

（単位：100 万ペソ）

	t_{-2}	t_{-1}	t_0	t_{+1}	t_{+2}	t_{+3}	t_{+4}以降
Lipa 市	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan 市	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas 市	490.90	622.65	652.83	637.89	599.49	742.28	1208.61

（出所）Yoshino and Pontines (2015)より筆者作成

Completion

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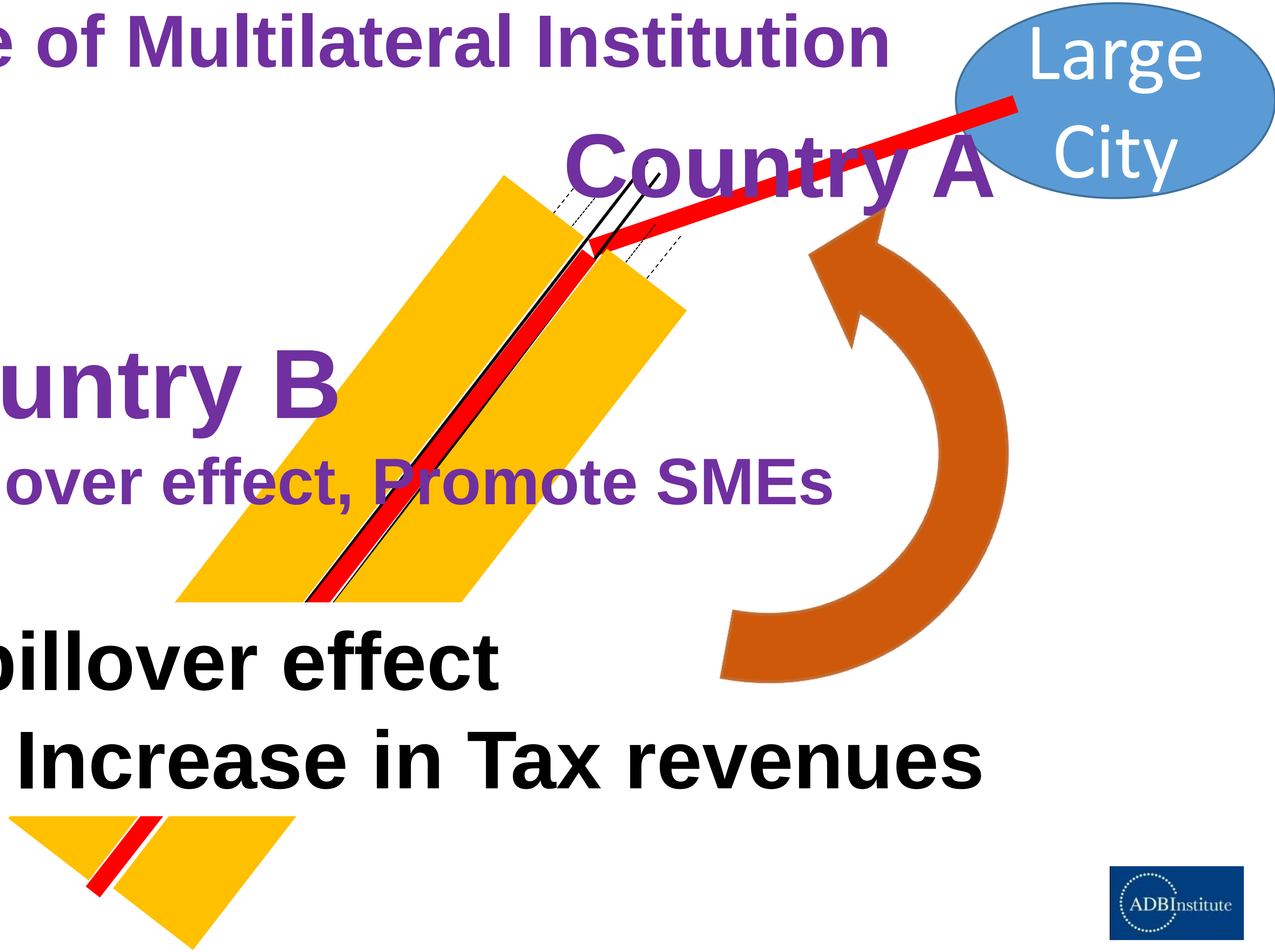
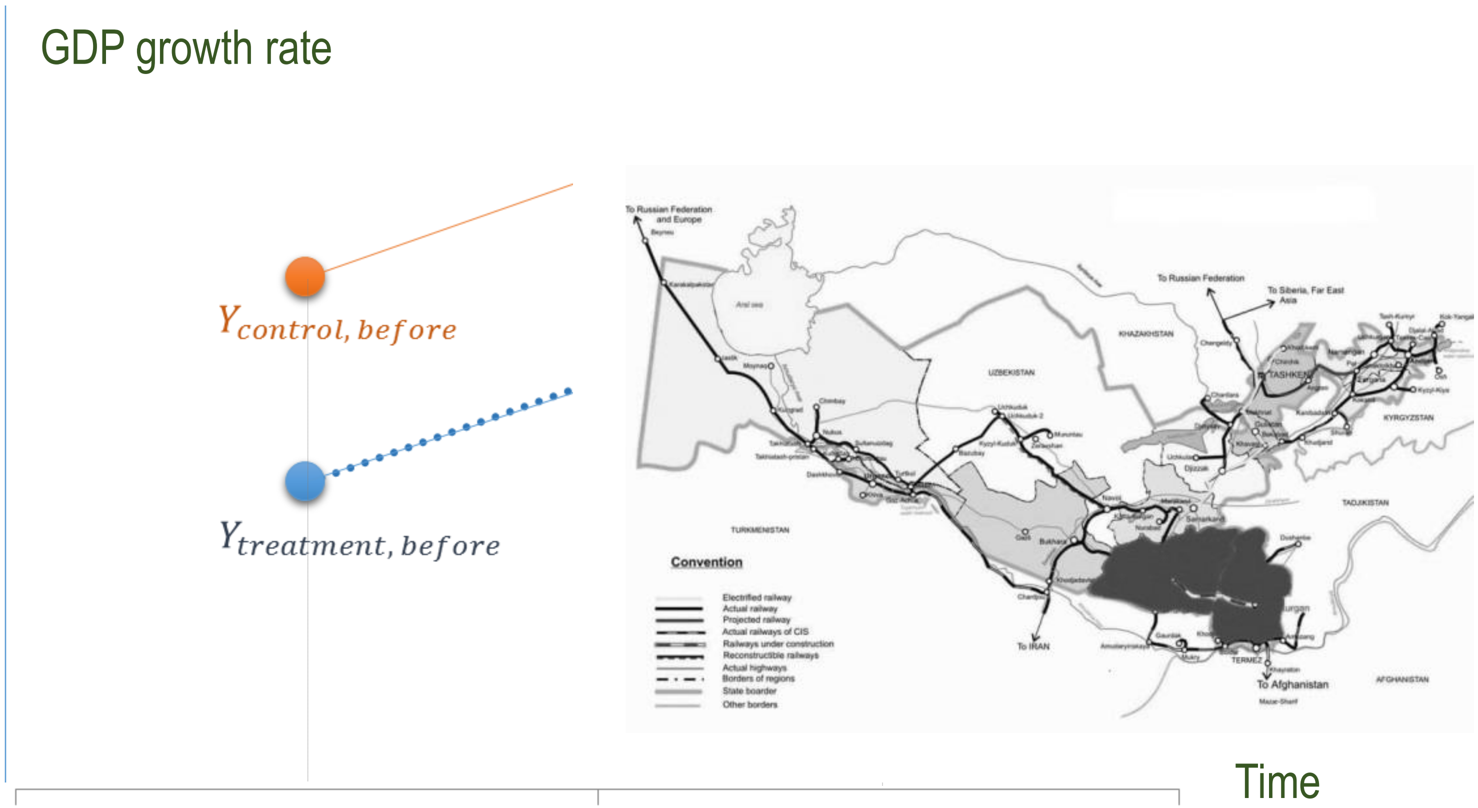
Cross-border Infrastructure Investment

Role of Multilateral Institution



Spillover effect
→ Increase in Tax revenues

Uzbekistan Railway



Divide regions affected and not affected by railway connection to “Treated group” and “Control group”

GDP

GDP	Term	Connectivity effect	Regional effect	Spillover effect
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]
1 year: 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

Additional tax revenue, Regional GDP growth and Railway Company Net Income, LCU (bln.)

Period	Coefficients	**T(20)*ΔY (Tax revenue)**	**ΔY Affected (Direct + Spillover effects)**	**Company net income (Revenue - Costs)**
Short term (2009-2010)	2.83*** [4.48]	**16.0**	**79.9**	**315.5**
Mid-term (2009-2011)	2.48*** [6.88]	**16.3**	**81.5**	**411.7**
Long-term (2009-2012)	2.06*** [3.04]	**14.7**	**73.5**	**509.0**

Source: Authors' calculatios

Japanese Bullet Train

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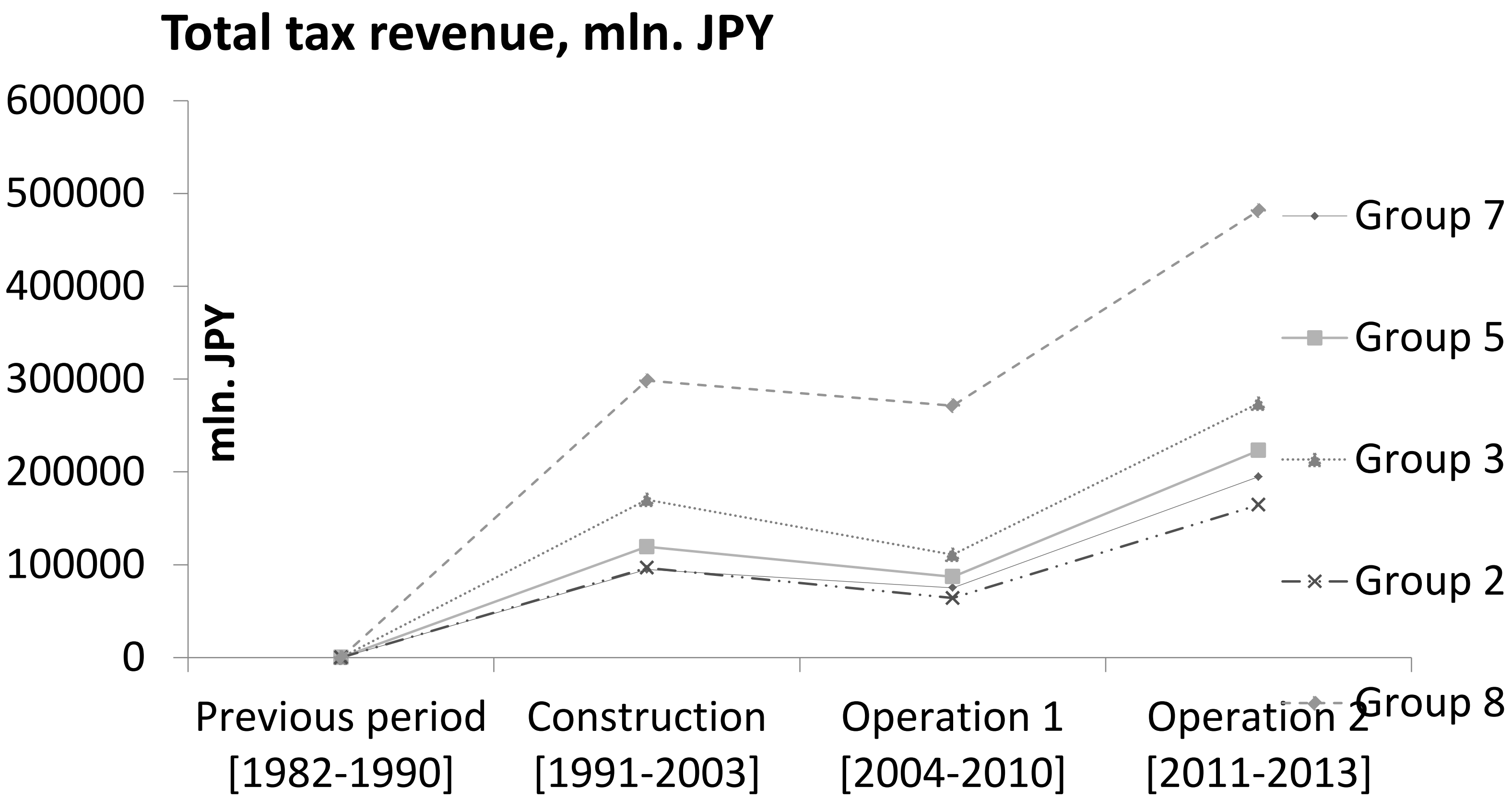
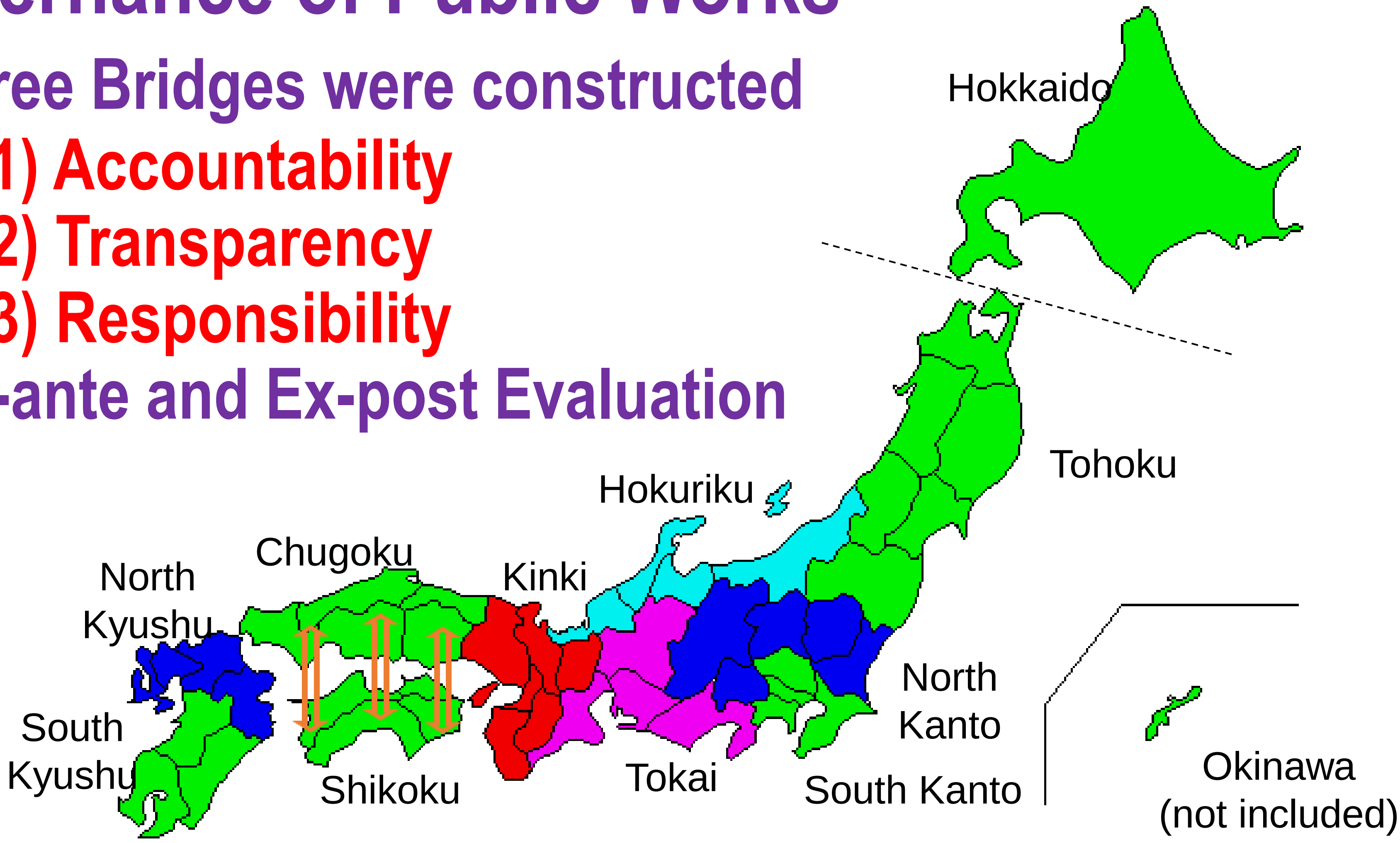

Total tax revenue, mln. JPY
600000
500000
400000
300000
200000
100000
0
mln. JPY
Previous period [1982-1990]
Construction [1991-2003]
Operation 1 [2004-2010]
Operation 2 [2011-2013]
Group 7
Group 5
Group 3
Group 2
Group 8

Map of Japan
Governance of Public Works

Three Bridges were constructed

(1) Accountability
(2) Transparency
(3) Responsibility

Ex-ante and Ex-post Evaluation



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