Financing for Infrastructure and The Way to Increase Rate of Return

Naoyuki Yoshino

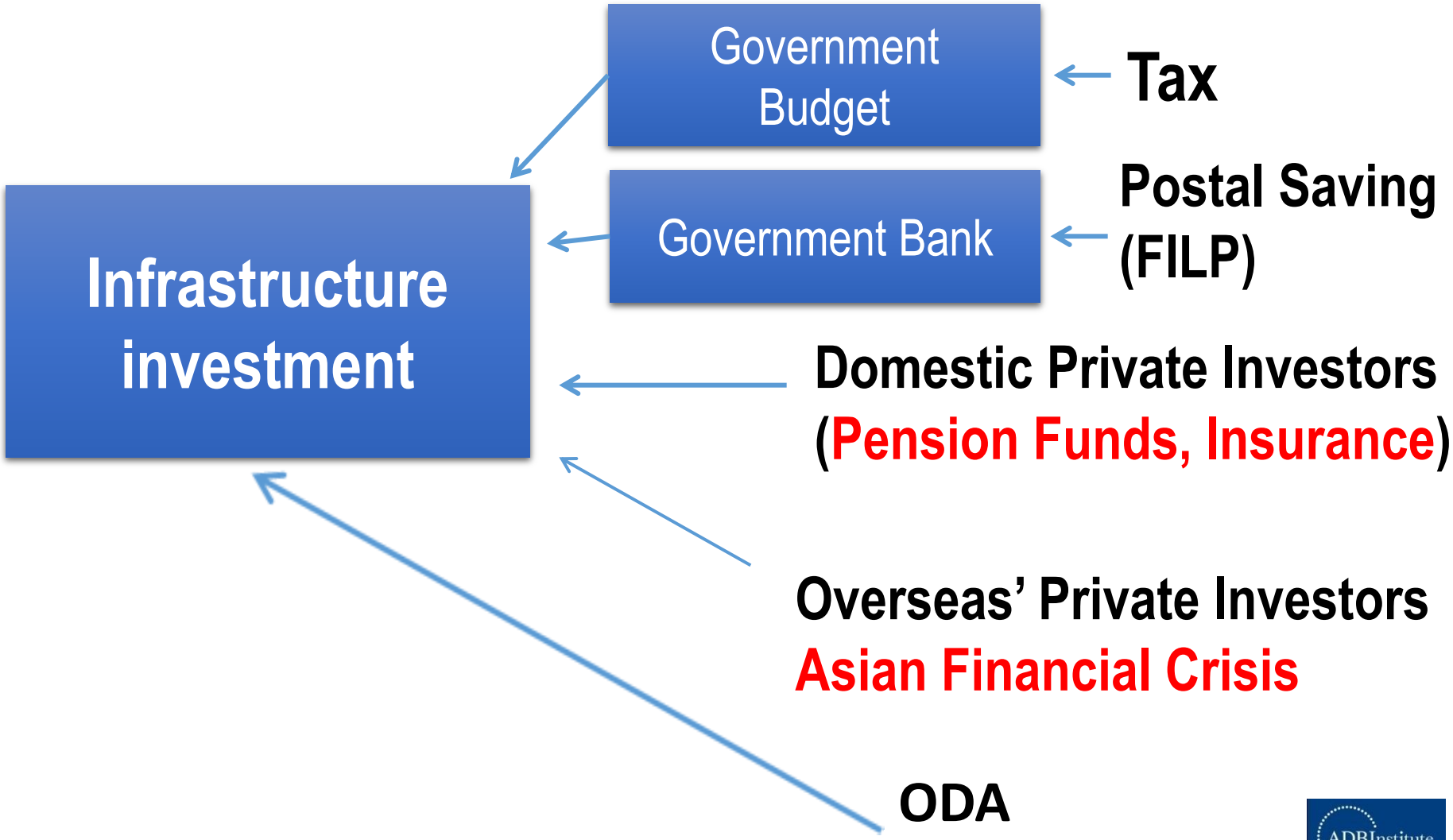
Dean, Asian Development Bank Institute (ADBI)

Professor Emeritus Keio University

nyoshino@adbi.org

ADBInstitute

Infrastructure Finance: Use of long term domestic savings

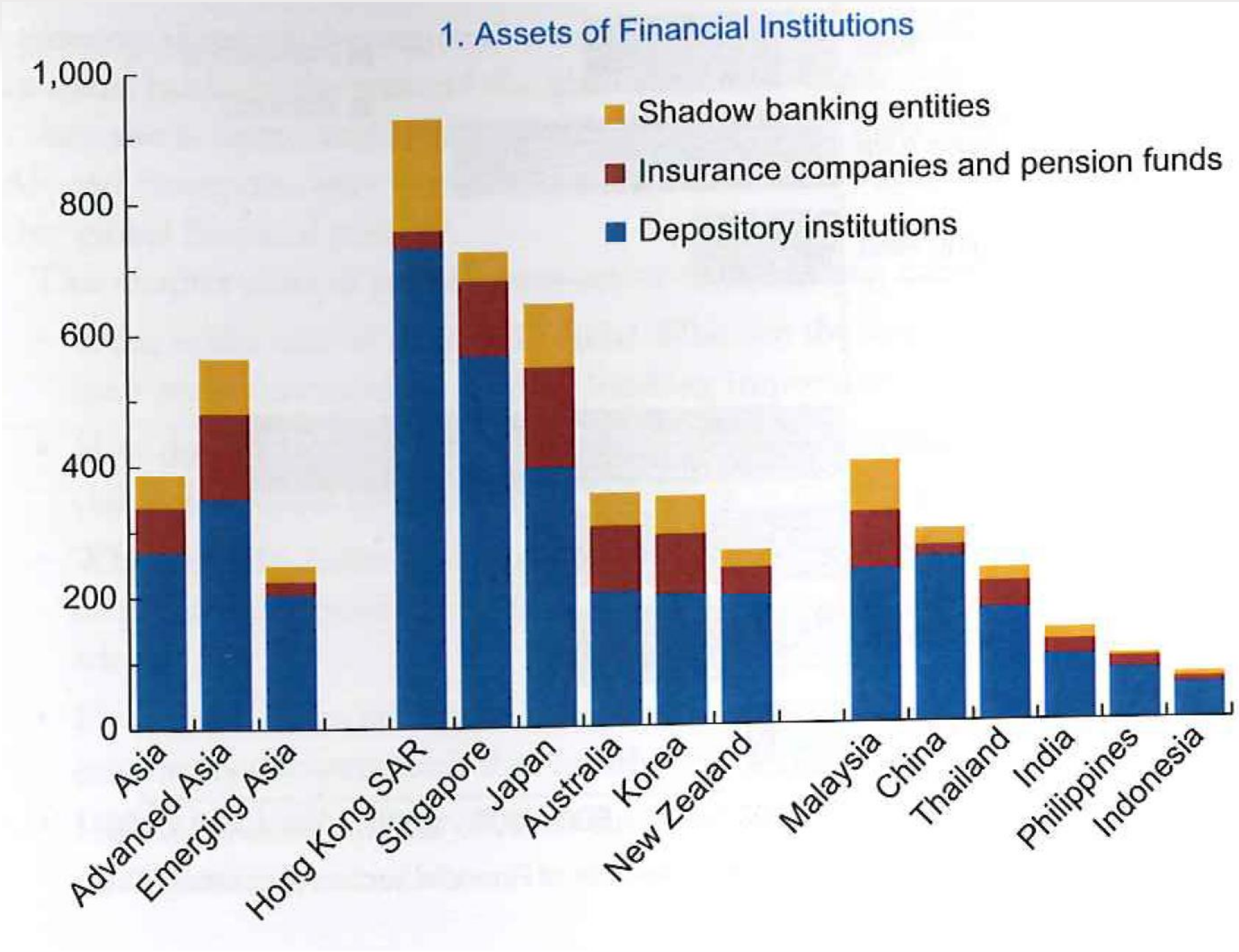


Long term and Patient investors are needed

1. Bank deposits – Bank loans (2-5 years)
2. Life insurance (20 years, 30 years)
3. Pension funds (20, 30, 40 years)

Long term financing

4. Asset Management of long term instruments
5. Financial education has to be developed

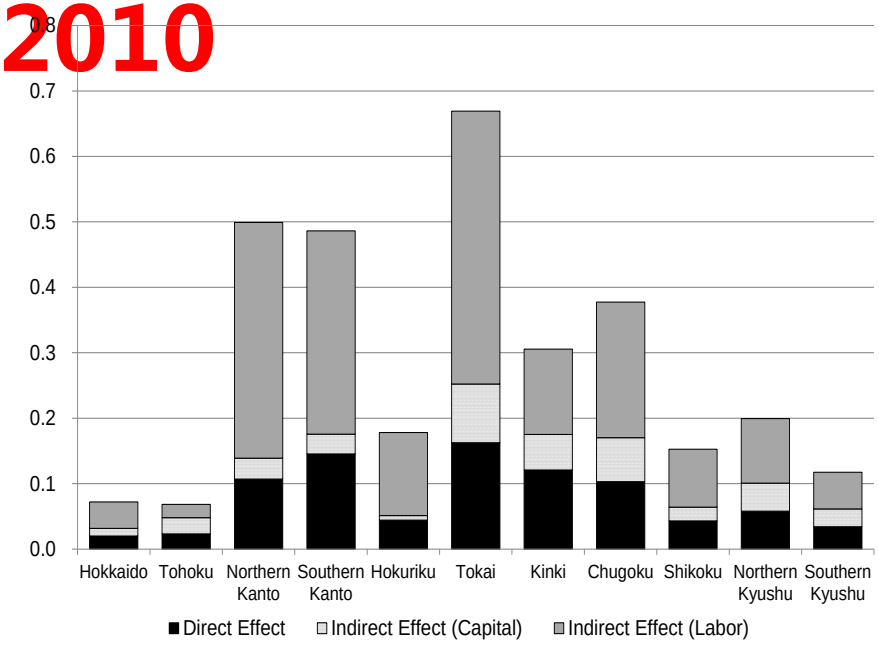

1. Assets of Financial Institutions
1,000
800
600
400
200
0
Shadow banking entities
Insurance companies and pension funds
Depository institutions
Asia
Advanced Asia
Emerging Asia
Hong Kong SAR
Singapore
Japan
Australia
Korea
New Zealand
Malaysia
China
Thailand
India
Philippines
Indonesia

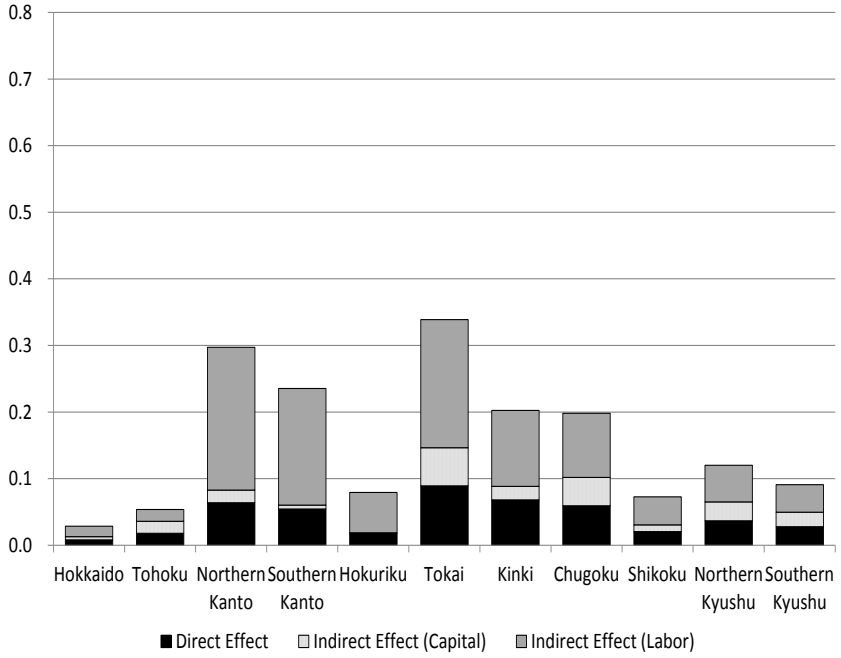
Regional Disparities of Economic Effects

large differences in Spillover effects

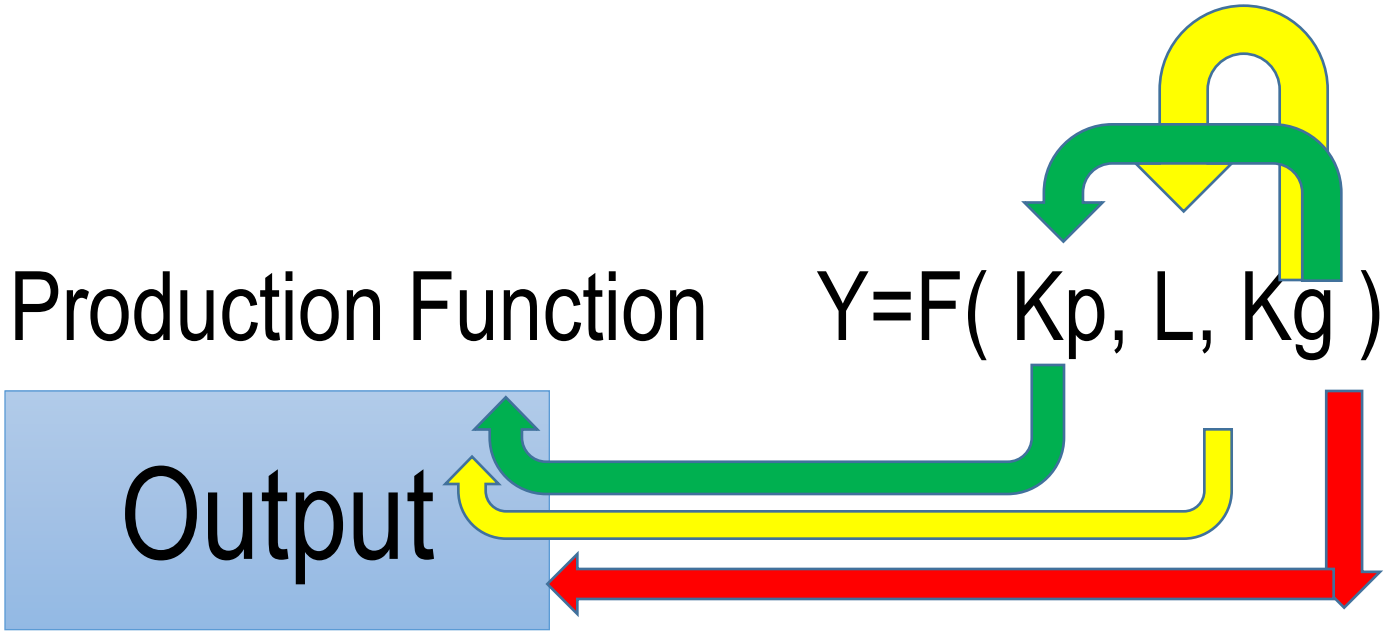
1990

2010





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.

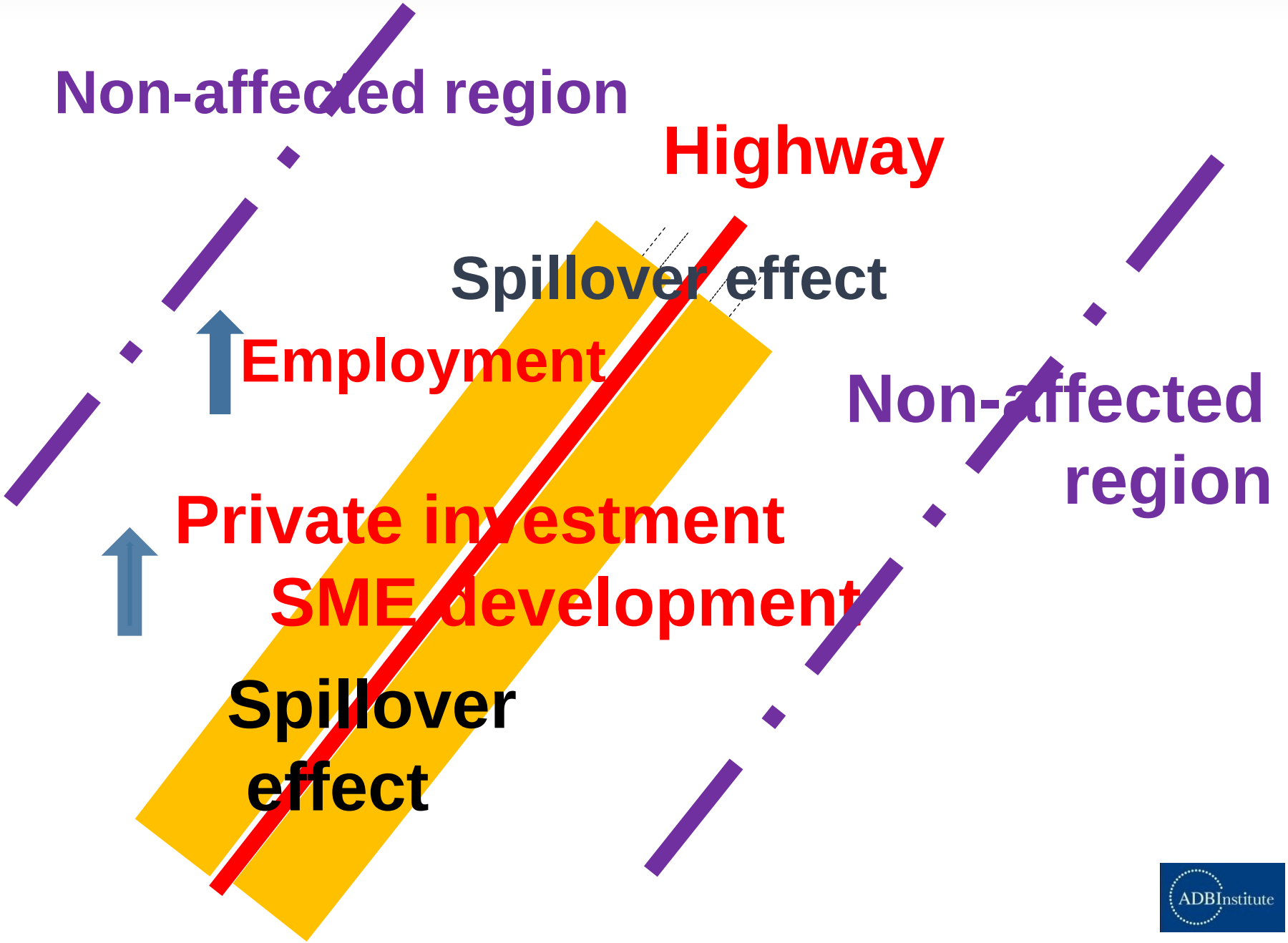
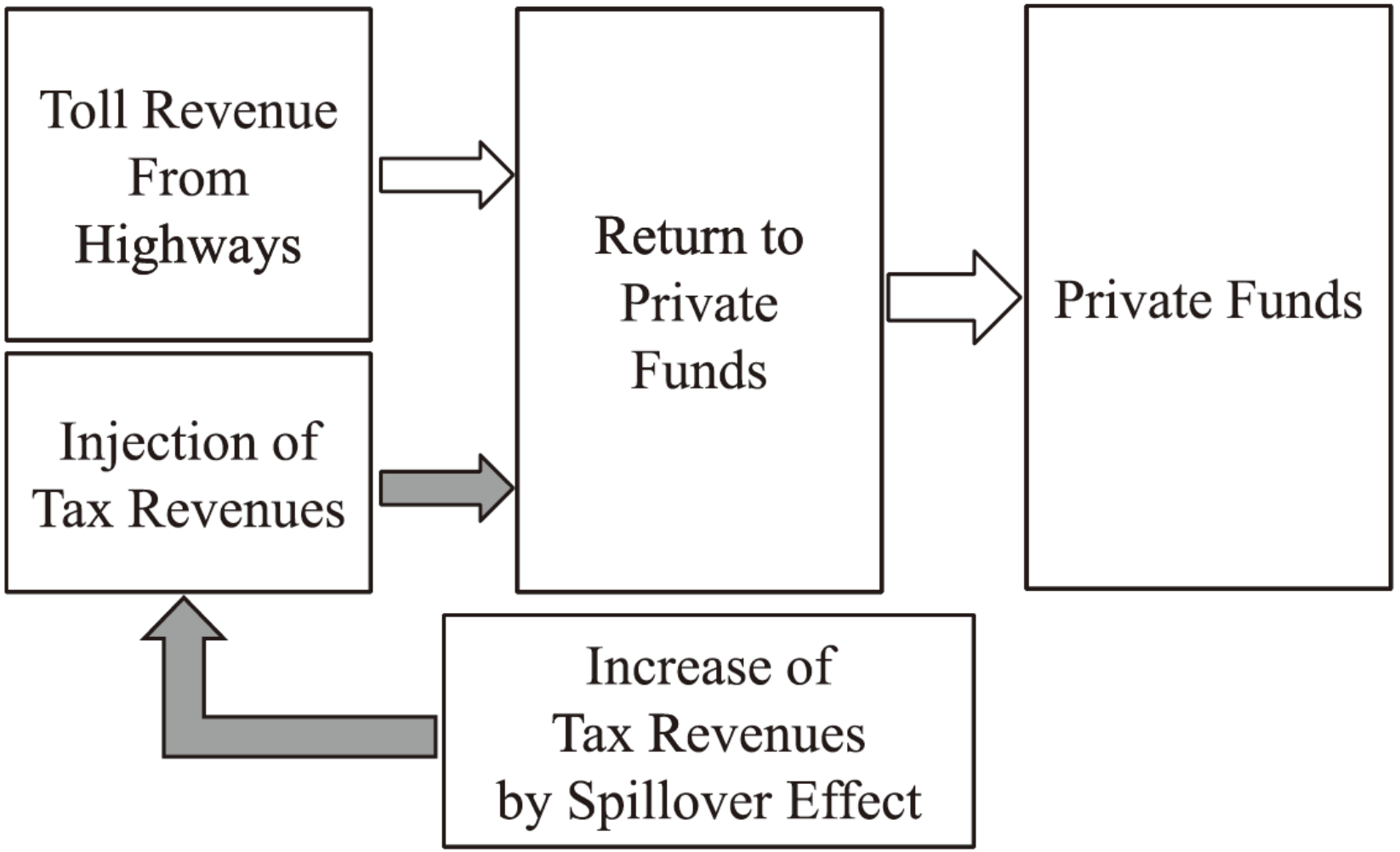

Non-affected region
Highway
Spillover effect
Employment
Non-affected region
Private investment
SME development
Spillover effect

Figure 4
Injection of a fraction of tax revenues gained from spillover effect



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(TOKYO)	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

2010 Services Sector	Private Capital	Public Capital	Direct Effect	Indirect Effect		20% Returned	Increment (%)
				Capital	Labor		
Hokkaido	0.197	0.122	0.043	0.053	0.027	0.016	37.2
Tohoku	0.222	0.189	0.066	0.107	0.015	0.025	37.0
Northern Kanto	0.235	0.273	0.095	0.124	0.054	0.036	37.5
Southern Kanto(TOKYO)	0.254	0.917	0.315	0.444	0.158	0.120	38.2
Hokuriku	0.220	0.217	0.075	0.118	0.024	0.028	37.8
Tokai	0.203	0.429	0.149	0.176	0.105	0.056	37.8
Kinki	0.202	0.316	0.110	0.131	0.075	0.041	37.7
Chugoku	0.212	0.121	0.044	0.068	0.010	0.016	35.6
Shikoku	0.224	0.193	0.069	0.099	0.026	0.025	36.3
Northern Kyushu	0.213	0.178	0.063	0.087	0.028	0.023	36.3
Southern Kyushu	0.228	0.157	0.057	0.090	0.009	0.020	34.7

Spillover effects → Return to investors

	1956-60	1961-65	1966-70	1971-75	1976-80	1981-85
Direct Effect (Kg)	0.696	0.737	0.638	0.508	0.359	0.275
Indirect Effect (Kp)	0.453	0.553	0.488	0.418	0.304	0.226
Indirect Effect (L)	1.071	0.907	0.740	0.580	0.407	0.317
20%Returned	0.3048	0.292	0.2456	0.1996	0.1422	0.1086
%Increment	43.8	39.6	38.5	39.3	39.6	39.5

1986-90	1991-95	1996-00	2001-05	2006-10
0.215	0.181	0.135	0.114	0.108
0.195	0.162	0.122	0.1	0.1
0.193	0.155	0.105	0.09	0.085
0.0776	0.0634	0.0454	0.038	0.037
36.1	35.0	33.6	33.3	34.3

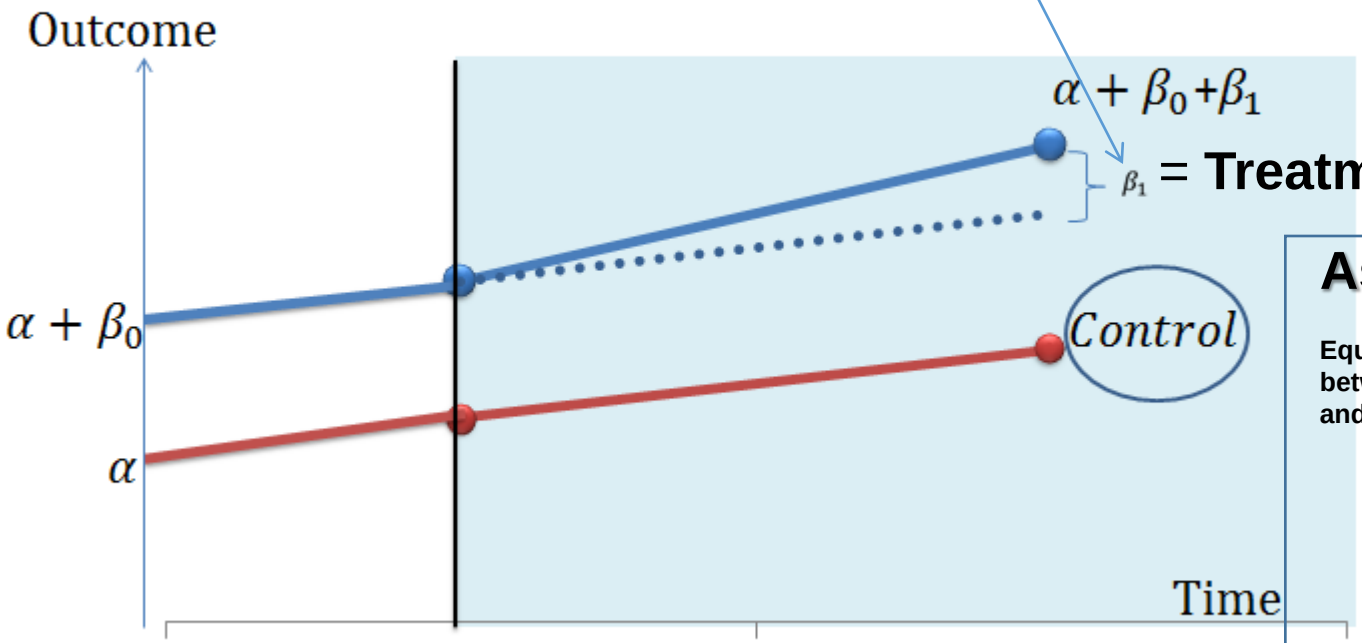
Case Study: Southern Tagalog Arterial Ro (STAR) , Philippines Micro-data

- 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%.

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

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）

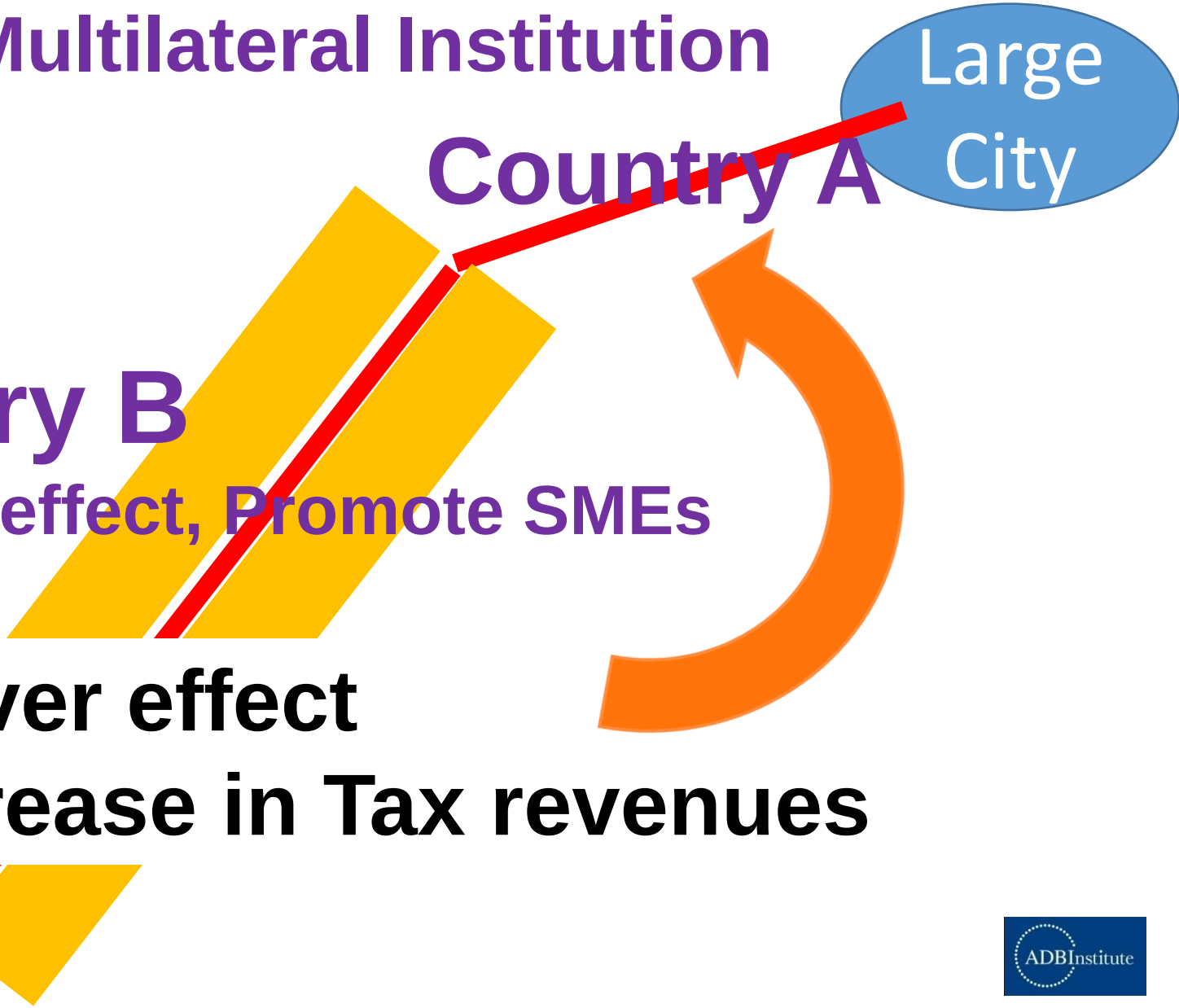
	t_{-2}	t_{-1}	t_0	t_{+1}	t_{+2}	t_{+3}	t_{+4}以降
Lipa 市	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan 市	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas 市	490.90	622.65	652.83	637.89	599.49	742.28	1208.61

（出所）Yoshino and Pontines (2015)より筆者作成

Completion

Cross-border Infrastructure Investment

Role of Multilateral Institution



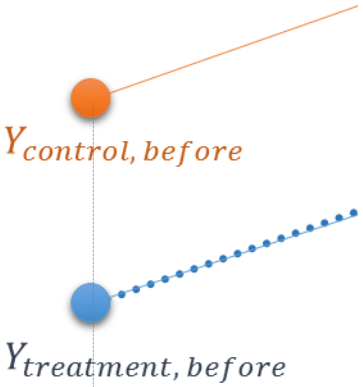
Spillover effect

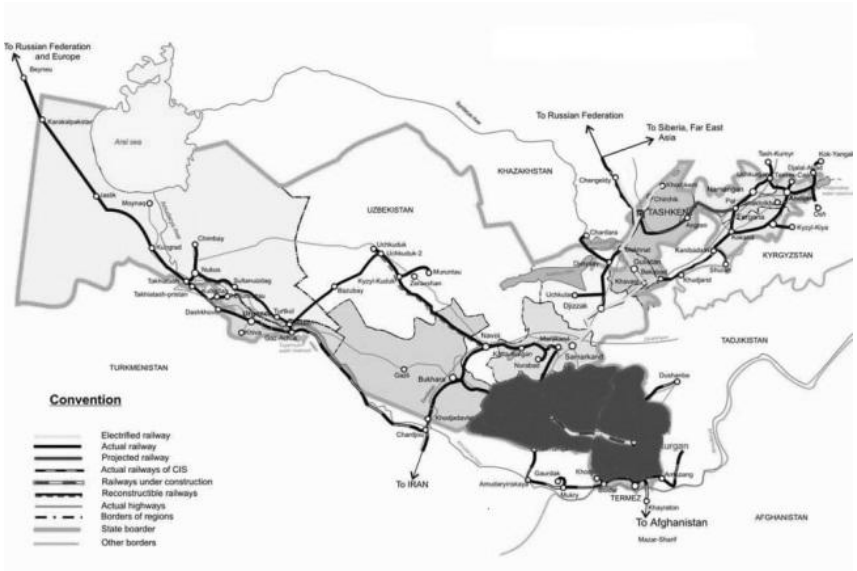
→ Increase in Tax revenues

ADBInstitute

Uzbekistan Railway

GDP growth rate





Time

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

Difference-in-difference: regression

- incorporating time varying covariates

  Control group $E[\Delta Y_{0it}|i,t,X_{it}] = \alpha + \gamma_i + \varphi_t + X'_{it}\beta$

  Treated group $E[\Delta Y_{1it}|i,t,X_{it}] = E[Y_{0it}|i,t,X_{it}] + \delta$

- $\Delta Y_{it} = \alpha_i + \varphi_t + X'_{it}\beta + \delta\left(D_{rail} \times D_{post}\right)_{it} + \epsilon_{it}$

  ΔY_{it} - GDP growth rate

  α_i - sum of autonomous (α) and region specific(γ_i) rate of growth

  φ_t- year specific growth effect

  X_{it}-time varying covariates

  $\left(D_{rail} \times D_{post}\right)_{it}$-dummy variable indicating that observation belong to treated group after treatment period

  δ- difference in difference coefficient

  ϵ_{it}- error term

GDP



GDP	Term	Connectivity spillover effect	Regional spillover effect	Neighbourng sillover 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]
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]
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.)

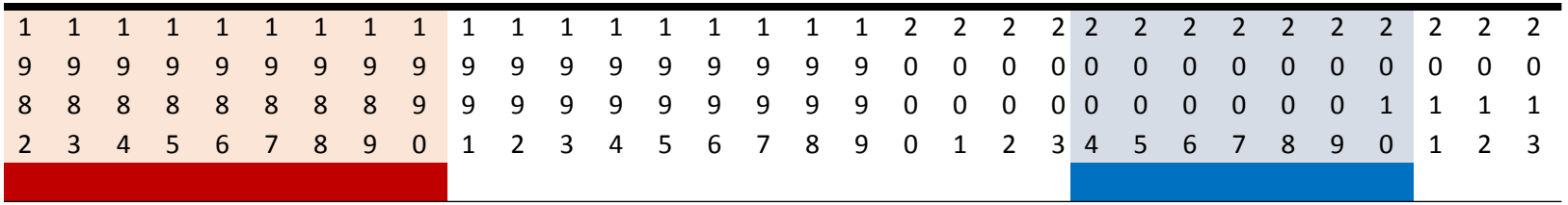
Period	Coefficients	T(20)*ΔY (Tax revenue)	ΔY Affected (Direct + Spillover effects)	Company net income (Revenue - Costs)
Short term (2009-2010)	2.83*** [4.48]	16.0	79.9	315.5
Mid-term (2009-2011)	2.48*** [6.88]	16.3	81.5	411.7
Long-term (2009-2012)	2.06*** [3.04]	14.7	73.5	509.0

Source: Authors' calculations

Japanese Bullet Train

Impact of Kyushu Shinkansen Rail on CORPORATE TAX revenue during 1st PHASE OF OPERATION period

{2004-2010} , mln. JPY (adjusted for CPI, base 1982)



Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Treatment2	-4772.54				
	[-0.2]				
Number of tax payers	5.8952514*	5.8957045*	5.896112*	5.8953585*	5.8629645*
	[1.95]	[1.95]	[1.95]	[1.95]	[1.91]
Treatment3		-15947.8			
		[-0.87]			
Treatment5			-13250.4		
			[-1.06]		
Treatment7				-6883.09	
				[-0.7]	
TreatmentCon					-28030.8
					[-0.65]
Constant	-665679	-665418	-665323	-665358	-658553
	[-1.35]	[-1.35]	[-1.35]	[-1.35]	[-1.32]
N	799	799	799	799	799
R2	0.269215	0.269281	0.269291	0.269241	0.269779
F	1.934589	2.106448	2.074548	2.100607	8.497174

COMPOSITION OF GROUPS

Group2	**Group5**
Kagoshima	Kagoshima
Kumamoto	Kumamoto
	Fukuoka
Group3	Oita
Kagoshima	Miyazaki
Kumamoto	
Fukuoka	
	GroupCon
Group7	Kagoshima
Kagoshima	Kumamoto
Kumamoto	Fukuoka
Fukuoka	Osaka
Oita	Hyogo
Miyazaki	Okayama
Saga	Hiroshima
Nagasaki	Yamaguchi

Note: Treatment2 = Time Dummy {1991-2003} x Group2. etc. t-values are in parenthesis. Legend: * p<.1; ** p<.05; *** p<.01. Clustering standard errors are used, allowing for heteroscedasticity and arbitrary autocorrelation within a prefecture, but treating the errors as uncorrelated across prefectures

Impact of Kyushu Shinkansen Rail on CORPORATE TAX revenue during 2nd PHASE OF OPERATION period

{2011-2013} , mln. JPY (adjusted for CPI, base 1982)

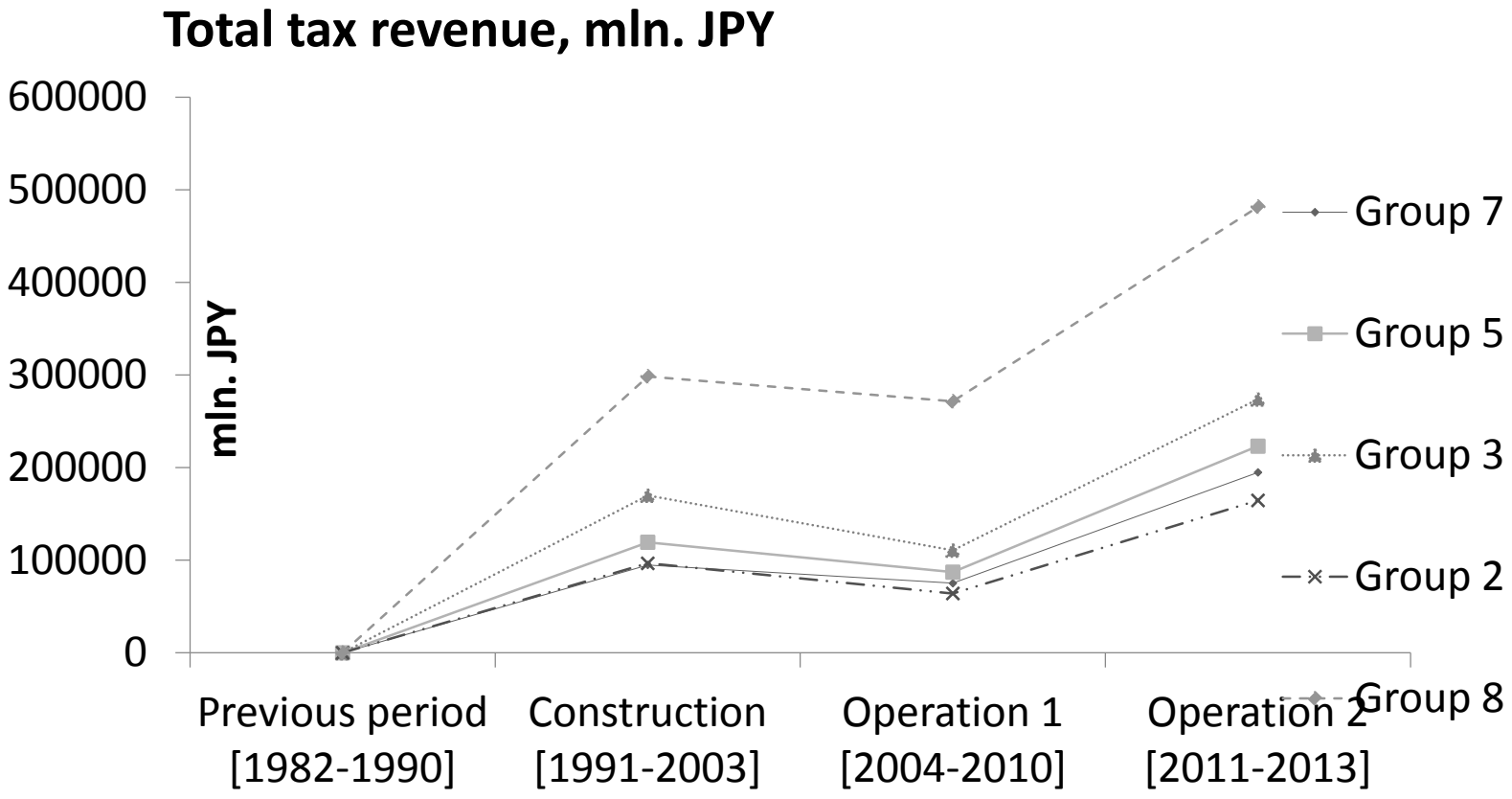
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1988	1989	1990		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010

Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Treatment2	72330.012**				
	[2.2]				
Number of tax payers	5.5277056***	5.5585431***	5.558603***	5.5706545***	5.9640287***
	[3.13]	[3.14]	[3.14]	[3.14]	[3.07]
Treatment3		104664.34*			
		[2]			
Treatment5			82729.673**		
			[2.1]		
Treatment7				80998.365**	
				[2.34]	
TreatmentCon					179632
					[1.58]
Constant	-568133.98**	-573747.28**	-574245.87**	-576867.56**	-642138.87**
	[-2.07]	[-2.08]	[-2.08]	[-2.09]	[-2.1]
N	611	611	611	611	611
R2	0.350653	0.352058	0.352144	0.352874	0.364088
F	5.062509	5.486197	5.351791	5.431088	16.55518

COMPOSITION OF GROUPS

Group2	Group5
Kagoshima	Kagoshima
Kumamoto	Kumamoto
	Fukuoka
Group3	Oita
Kagoshima	Miyazaki
Kumamoto	
Fukuoka	
	GroupCon
Group7	Kagoshima
Kagoshima	Kumamoto
Kumamoto	Fukuoka
Fukuoka	Osaka
Oita	Hyogo
Miyazaki	Okayama
Saga	Hiroshima
Nagasaki	Yamaguchi

Note: Treatment2 = Time Dummy {1991-2003} x Group2. etc. t-values are in parenthesis. Legend: * p<.1; ** p<.05; *** p<.01. Clustering standard errors are used, allowing for heteroscedasticity and arbitrary autocorrelation within a prefecture, but treating the errors as uncorrelated across prefectures

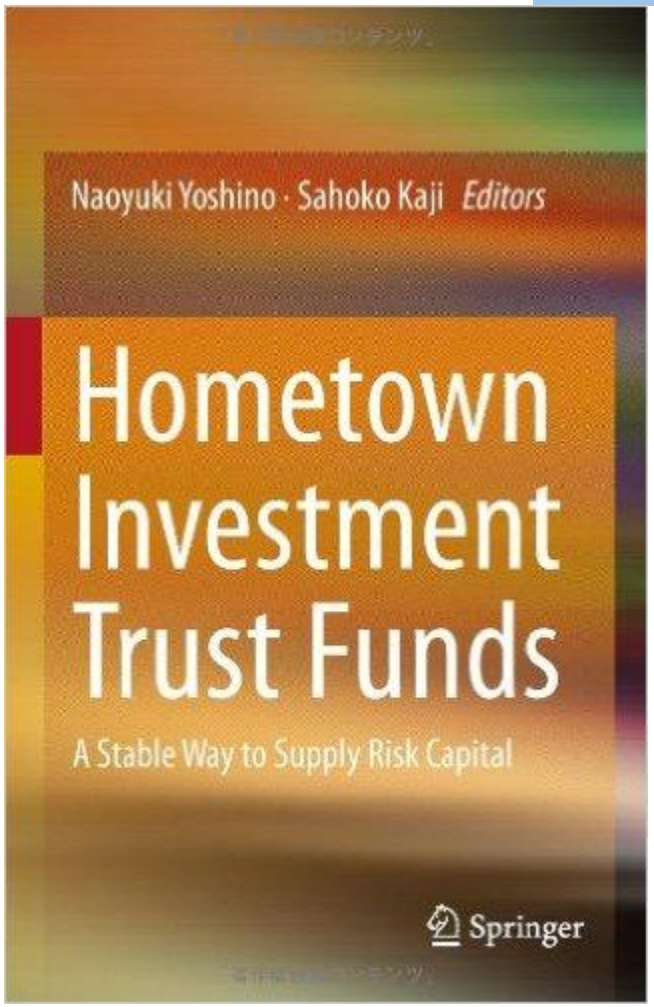

Total tax revenue, mln. JPY
600000
500000
400000
300000
200000
100000
0
mln. JPY
Previous period [1982-1990]
Construction [1991-2003]
Operation 1 [2004-2010]
Operation 2 [2011-2013]
Group 7
Group 5
Group 3
Group 2
Group 8

Public-Private Partnership (PPP)
Give incentives to operating entity

Payoff table for infrastructure operating entity and investors

	Normal Case	Effort Case
Normal Case	$(50, r)$ Operating Entity Investors	$(50, \alpha r)$ Operating Entity Investors
Effort Case	$(100, r)$ Operating Entity Investors	$(100, \alpha r)$ Operating Entity Investors

Possible Solutions
Start up businesses, farmers



Hometown Investment Trust Funds

A Stable Way to Supply Risk Capital

Yoshino, Naoyuki; Kaji, Sahoko (Eds.)
2013, IX, 98 p. 41 illus.,20 illus. in color

Available Formats:

ebook
Hardcover
Springer

Japan, Cambodia Vietnam, Peru

Investment in SMEs and start up businesses

すべてを失い再起を断念しそうになった時。

Agricultural Funds

Beans and Wine

References

Yoshino N. Kaji, S. (2013) *Hometown Investment Trust Funds*, Springer, March 2013

Yoshino, N., Taghizadeh Hesary, F. (2014), 'Analytical Framework on Credit Risks for Financing SMEs in Asia'. Asia-Pacific Development Journal. United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP)

Yoshino, N. and Taghizadeh Hesary F. (2015) "Analysis of Credit Ratings from Small and Medium-sized Enterprises: Evidence from Asia", Asian Development Review, Vol.32, No2

Yoshino, N. and Pontines, Victor (2015) "The Highway-Effect on Public Finance: Case of the STAR Highway in the Phillippines", GIE | AAA Special Kick-off Edition, GIE Network publishing.

Nakahigashi, M and Yoshino, N. (2016) “Changes in Economic Effect of Infrastructure and Financing Method”, Public Policy Review, Vol.12, No.1.

Yoshino, Naoyuki（2010）“Financing Transport Infrastructure Investment”, OECD（ed.）, Southeast Asian Economic Outlook 2010, OECD Publishing.

Yoshino, Naoyuki（2012）“Global Imbalances and the Development of Capital Flows among Asian Countries”, OECD Journal: Financial Market Trends, Vol. 2012/1

Yoshino, Naoyuki and Masaki Nakahigashi（2004）“The Role of Infrastructure in Economic Development”, ICFAI Journal of Managerial Economics, 2, pp. 7-24

Yoshino, Naoyuki and Victor Pontines（2015）“The Highway Effect on Public Finance: Case of the STAR Highway in the Philippines”, Asian Development Bank Institute（ADBI）Working Paper No.549.

Yoshino, Naoyuki, Victor Pontines and Umid Abidhadjaev（2015）“Impact Evaluation of Infrastructure Provision on Public Finance and Economic Performance: Empirical Evidence from Philippines and Uzbekistan”, Asian Development Bank Institute（ADBI）, Working Paper, No.548.

ADBInstitute