Economic Effects of Infrastructure in Asia-Pacific: Needs, Impacts and Finance

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Forthcoming Book on Infrastructure

"FINANCING INFRASTRUCTURE IN ASIA: Capturing Impacts and New Sources"

Edited by Naoyuki Yoshino, Matthias Helble, and Umid Abidhadjaev

- the latest evidence on the impact of infrastructure investment on economic and social indicators
- country studies on how infrastructure investment can increase output, taxes, trade and firm productivity
- innovative modes of infrastructure financing
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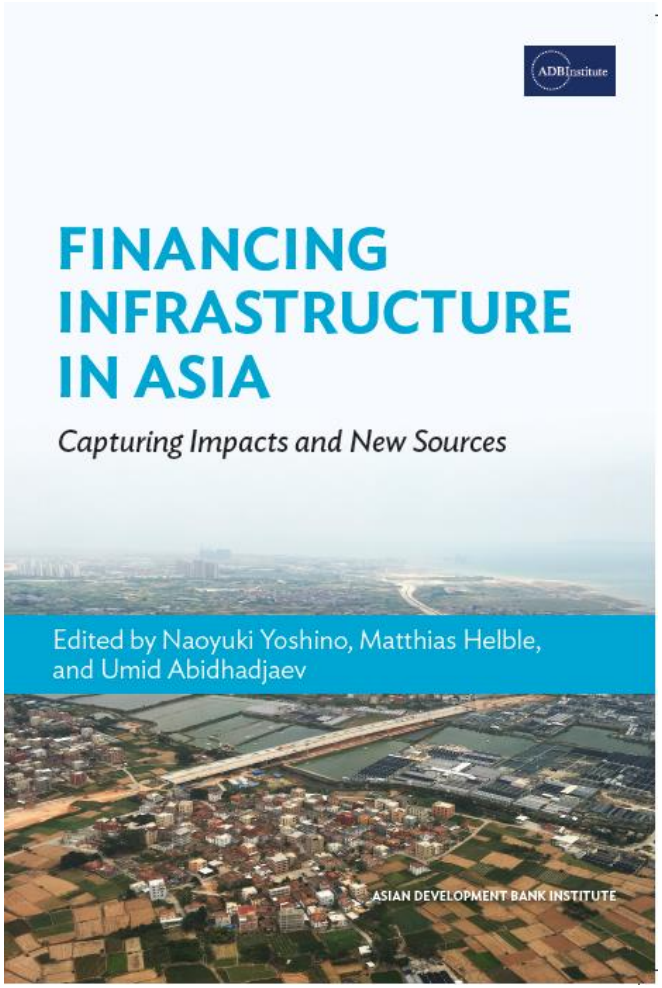

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Infrastructure Investment Needs in Asia-Pacific (2016-2030)

($ billion in 2015 prices, annual average)

	Baseline Total	% of GDP	Climate Adjusted	% of GDP
Central Asia	33	6.8	38	7.8
East Asia	919	4.5	1071	5.2
South Asia	365	7.6	423	8.8
Southeast Asia	184	5.0	210	5.7
The Pacific	2.8	8.2	3.1	9.1
Asia & Pacific	**1503**	**5.1**	**1744**	**5.9**

Source: Meeting Asia's Infrastructure Needs, ADB (2017)

Infrastructure Investment Needs by Sector, 2016-2030

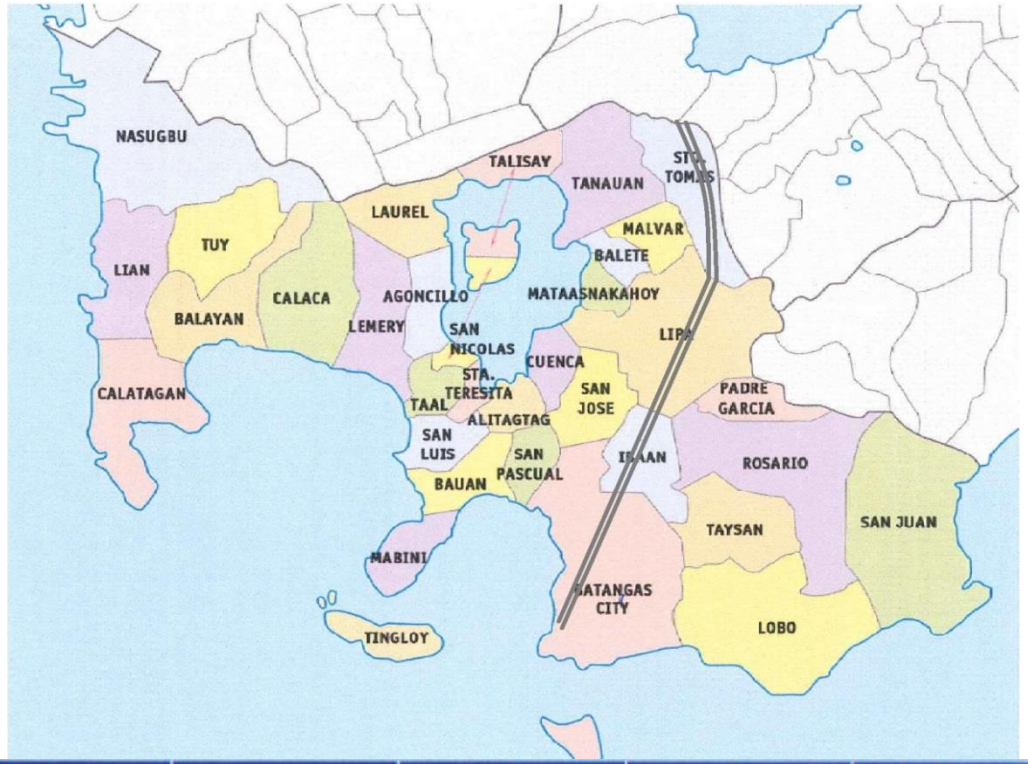
($ billion in 2015 prices, annual average)

	$ billion	% share to total	Adaptation ($ billion)	Mitigation ($billion)
Power	982	56.3	3	200
Transport	**557**	**31.9**	37	-
Telecommunications	152	8.7	-	-
Water and Sanitation	23	3.1	1	-
Total	**1744**	**100**	**41**	**200**

Source: Meeting Asia's Infrastructure Needs, ADB (2017)

Southern Tagalog Arterial Road (STAR) Philippines (Yoshino and Pontines, 2015)

- STAR tollway built to improve road linkage between Metro Manila and Batangas International Port.
- Tax revenue increased during construction and after completion in communes along the tollway.



	t_{-2}	t_{-1}	t_0	t_{+1}	t_{+2}	t_{+3}	t_{+4}, forward
Lipa City	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan City	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas City	490.90	622.65	652.83	637.89	599.49	742.28	1,208.61

Results

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	0.446	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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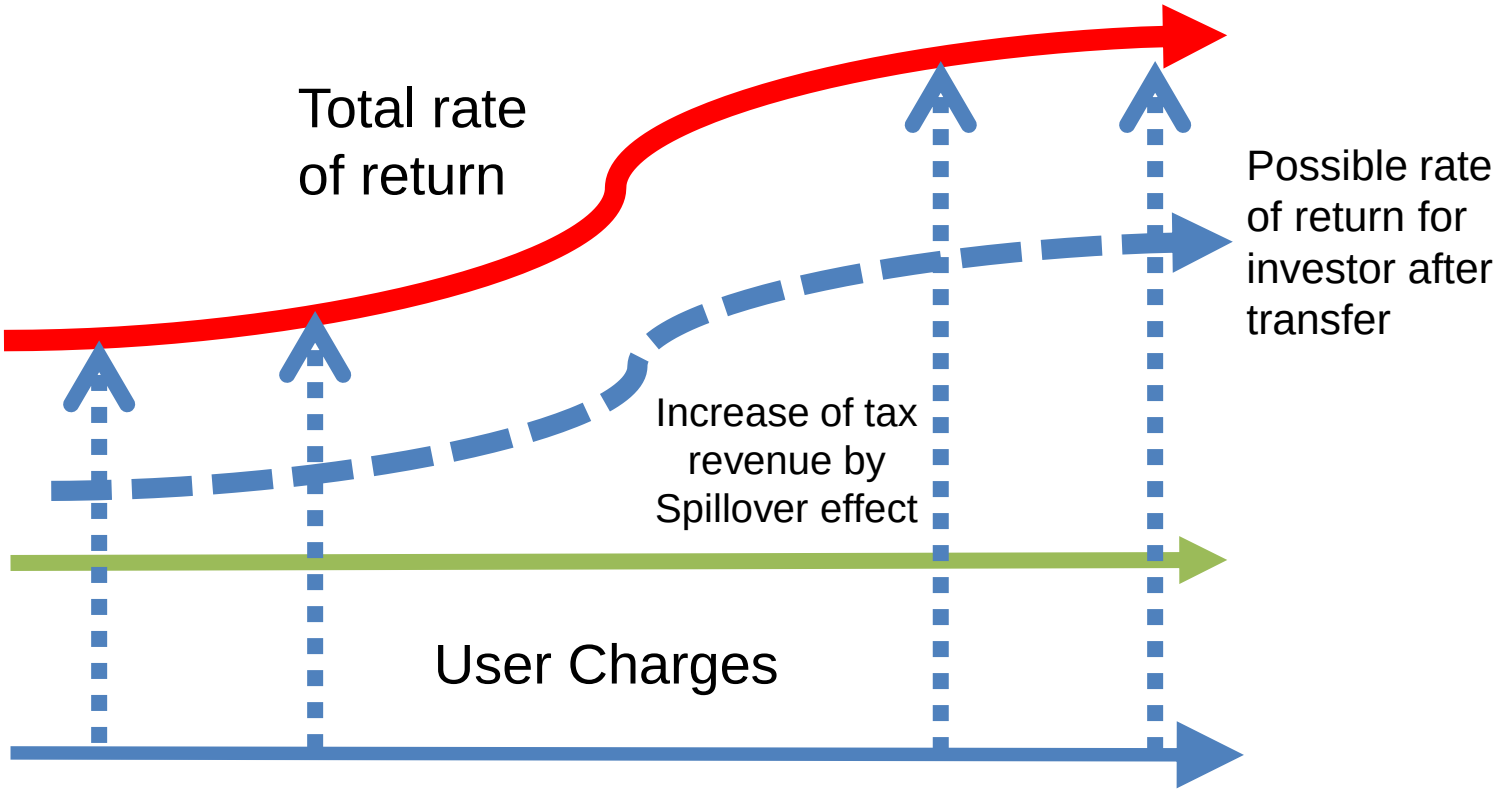
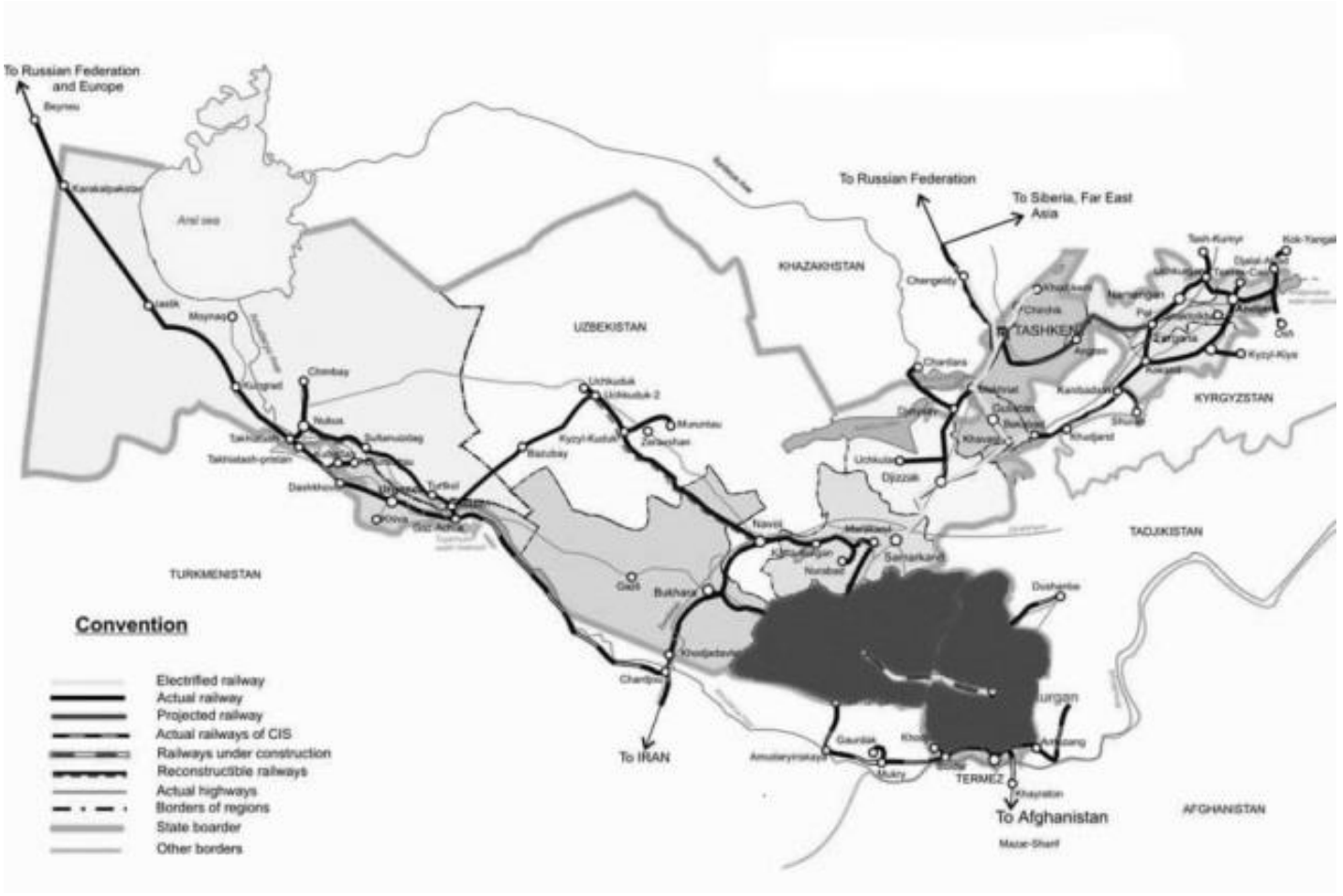
Injection of increased tax revenues to increase the rate of return



Uzbekistan Railway

(Yoshino and Abidhadjaev, 2017)



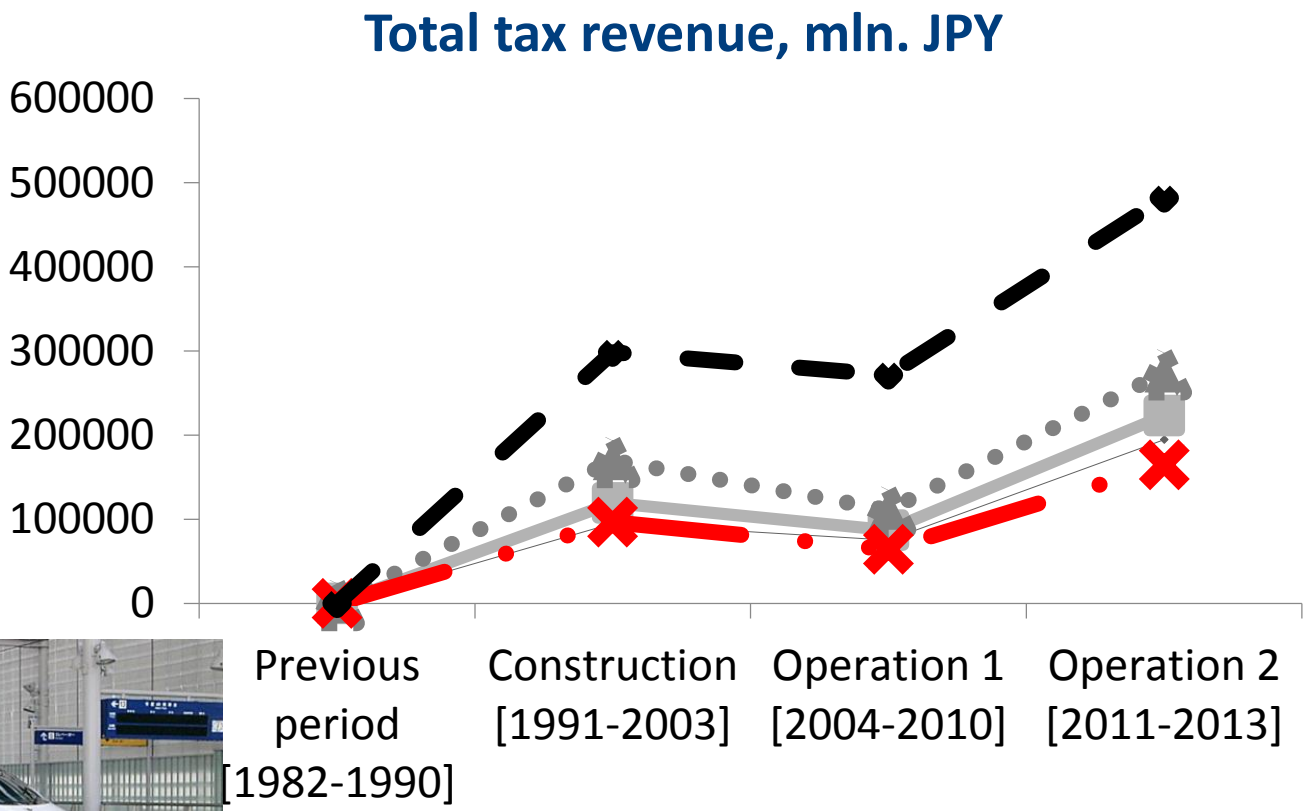
Impact is different across sectors, regions and time

GDP		Term	Connectivity spillover effect	Regional spillover effect	Neighboring spillover effect
Launching Effects		Short	2.83***[4.48]	0.70[0.45]	1.33[1.14]
		Mid	2.50***[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]

Source: Yoshino and Abidhadjaev, 2017

Japanese Bullet Train

(Yoshino and Abidhadjaev, 2017)



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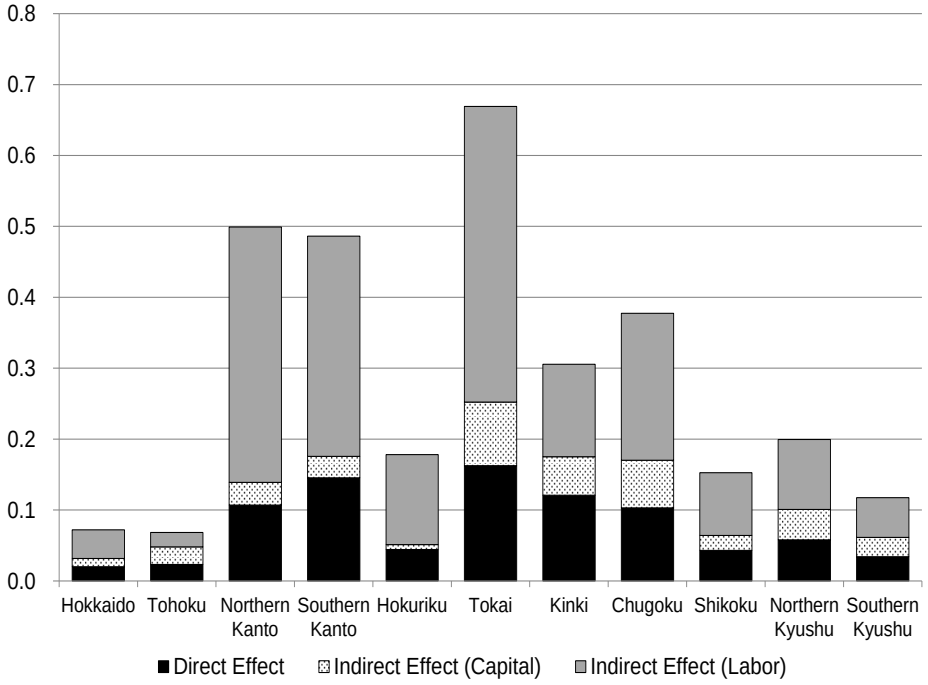
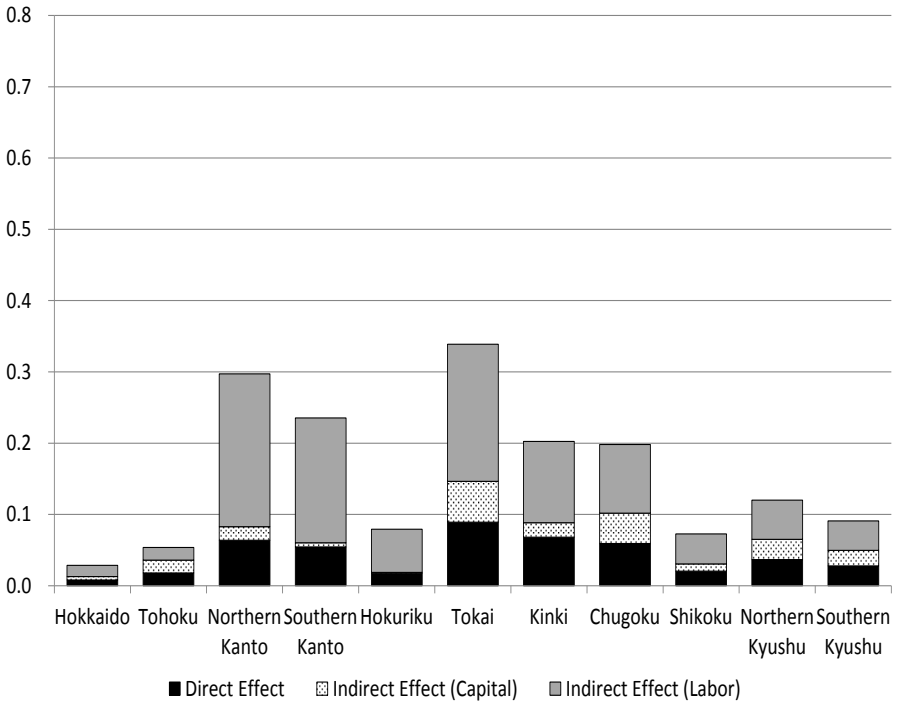
Regional Disparities of Economic Effects
Decreasing effects over time

Nakahigashi and Yoshino (2016)

1990



2010



Source: Nakahigashi and Yoshino (2016)

Table 1: Spillover Effects Estimated from a Macroeconomic Translog Production Function

	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(Kp)	0.452	0.557	0.493	0.389	0.270	0.203
Indirect effect(L)	1.071	0.973	0.814	0.639	0.448	0.350
20% returned	0.305	0.306	0.261	0.206	0.144	0.111
increment	0.438	0.415	0.410	0.404	0.400	0.402

	1986-90	1991-95	1996-00	2001-05	2006-10
Direct effect	0.215	0.181	0.135	0.114	0.108
Indirect effect(Kp)	0.174	0.146	0.110	0.091	0.085
Indirect effect(L)	0.247	0.208	0.154	0.132	0.125
20% returned	0.084	0.071	0.053	0.045	0.042
increment	0.392	0.392	0.390	0.390	0.391

Source: Authors' estimation based on Nakahigashi (2015)

Infrastructure & Education

Yoshino and Umid Abidhadjaev (2016)

- Steady state equation in logarithmic form

$$lny(2010) - lny(1991) =$$
$$\left(1 - e^{-\lambda t}\right)\left(\frac{\theta}{1-\theta-\beta-\alpha}\right) ln(\varphi) +$$
$$\left(1 - e^{-\lambda t}\right)\left(\frac{\beta}{1-\theta-\beta-\alpha}\right) ln(1-\varphi) +$$
$$\left(1 - e^{-\lambda t}\right)\left(\frac{\theta+\beta}{1-\theta-\beta-\alpha}\right) ln(\tau) +$$
$$\left(1 - e^{-\lambda t}\right)\left(\frac{\alpha}{1-\theta-\beta-\alpha}\right) ln\left(s(1-\tau)\right) -$$
$$\left(1 - e^{-\lambda t}\right)\frac{\alpha+\beta+\theta}{(1-\theta-\beta-\alpha)} ln(n+\delta+g) -$$
$$(1 - e^{-\lambda t}) lny(1991)$$

NOTE:
Context: 44 developing countries, 1991-2010
Methodology: Production function approach
Point of novelty and findings:
Study incorporated infrastructure variable into neoclassical growth framework and demonstrated that controlling for share of working age population with university level of education infrastructure investment to GDP ratio constituted statistically significant determinant of accumulated growth rate of GDP per capita

Dependent variable: log difference GDP per capita in 1991-2010			
Regression number	REG.1	REG.2	REG.3
Variables	Coef.	Coef.	Coef.
lnY_1991	-0.06	-0.14	-0.14
	(-0.54)	(-1.35)	(-1.38)
ln(n+g+d)	-3.09	-5.75	-4.36
	(-0.59)	(-1.23)	(-0.77)
ln(Kg)	0.23	0.31**	0.53***
	(1.17)	(2.00)	(3.30)
ln(Sec)			0.00
			(0.46)
ln(Kg)xln(Sec)	0.20*		
	(1.59)		
ln(Uni)			0.21**
			(2.07)
ln(Kg)xln(Uni)		0.24***	
		(2.76)	
Constant	-0.28	0.56	0.48
	(-0.33)	(0.69)	(0.57)
Number of observations	44.00	44.00	44.00
R-squared	0.21	0.30	0.30
F-statistic	2.62	4.14	3.29

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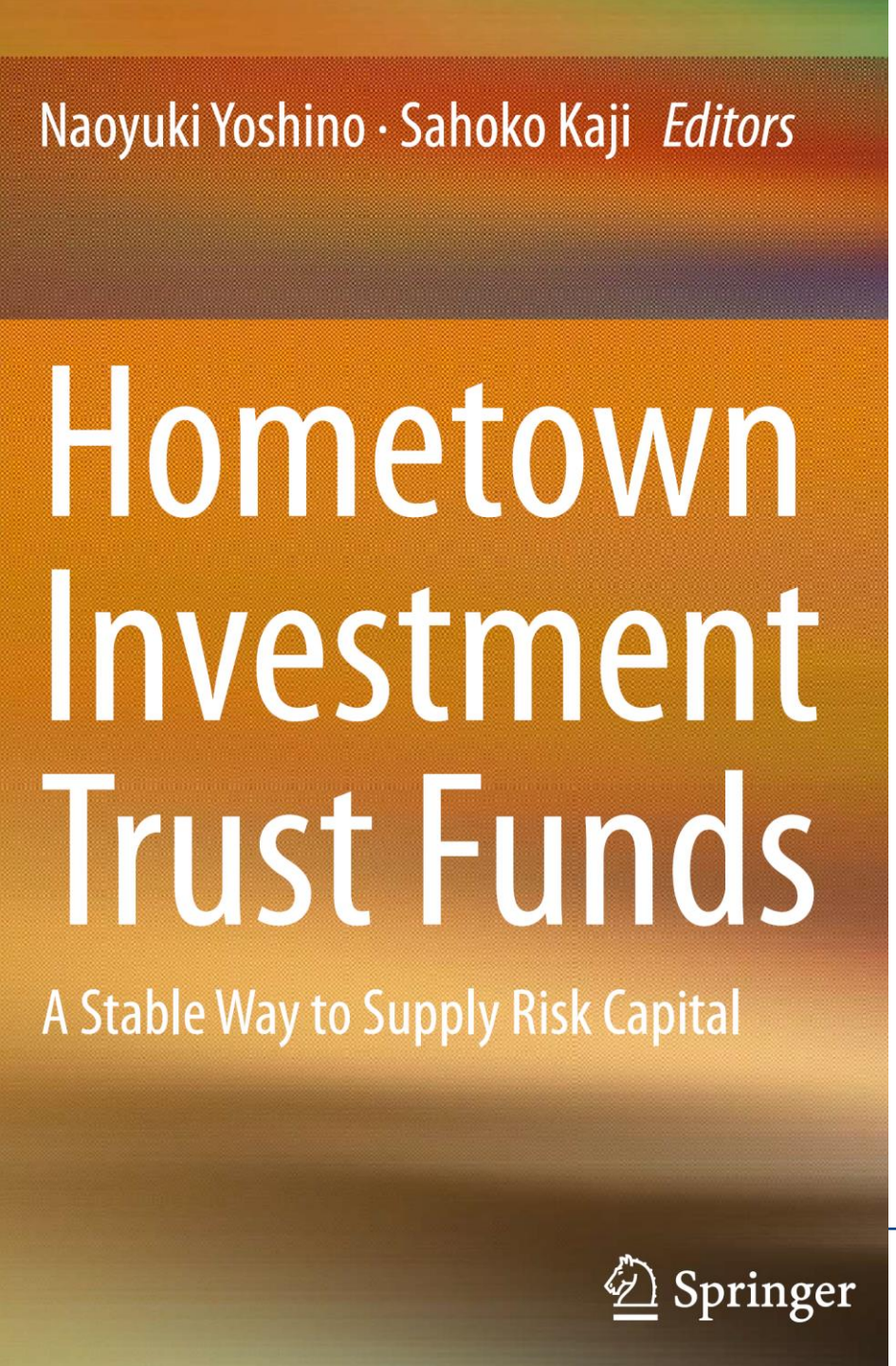

Hometown Investment Trust Funds : Springer

A Stable Way to Supply Risk Capital

Yoshino, Naoyuki; Kaji Sahoko (Eds.) 2013,

Japan, Cambodia Vietnam, Peru, Mongolia

Access to Digital Technology, Internet

Springer

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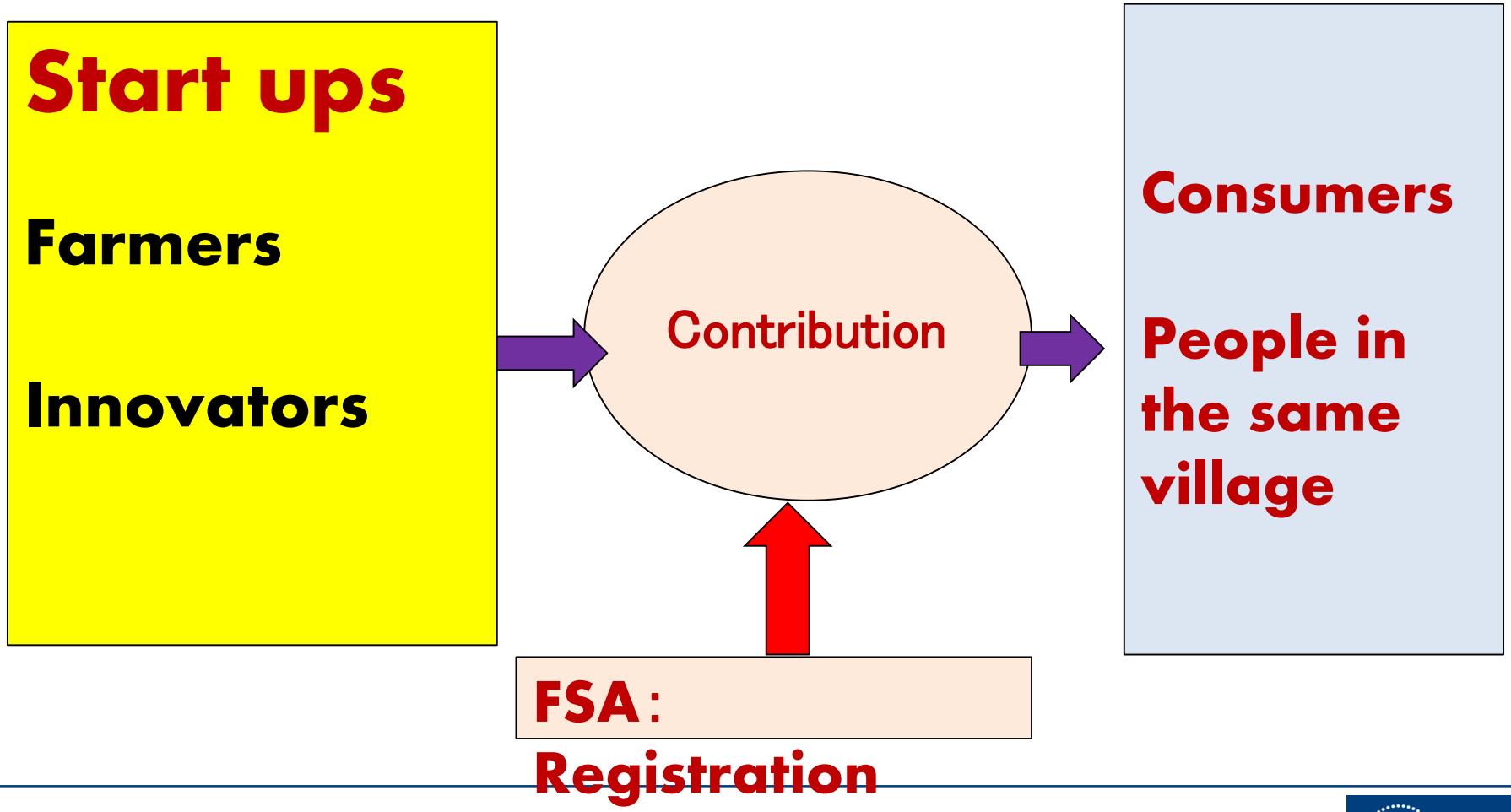
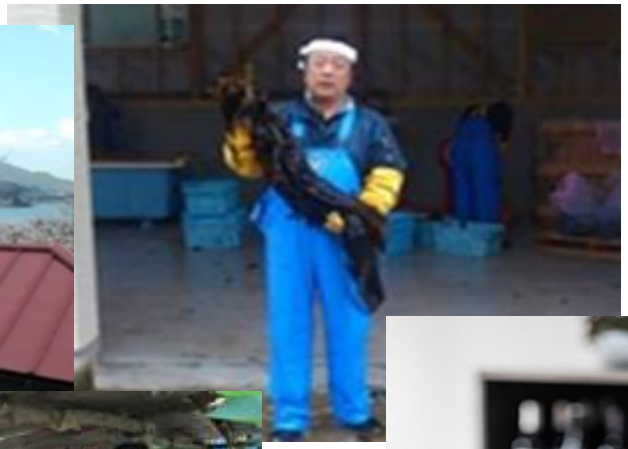
Hometown Investment to Start ups



Investment in Start-ups along roads



Cross-border Infrastructure Investment

Role of Multilateral Institution

Port

Country A

Country B

Spillover effect, Promote SMEs

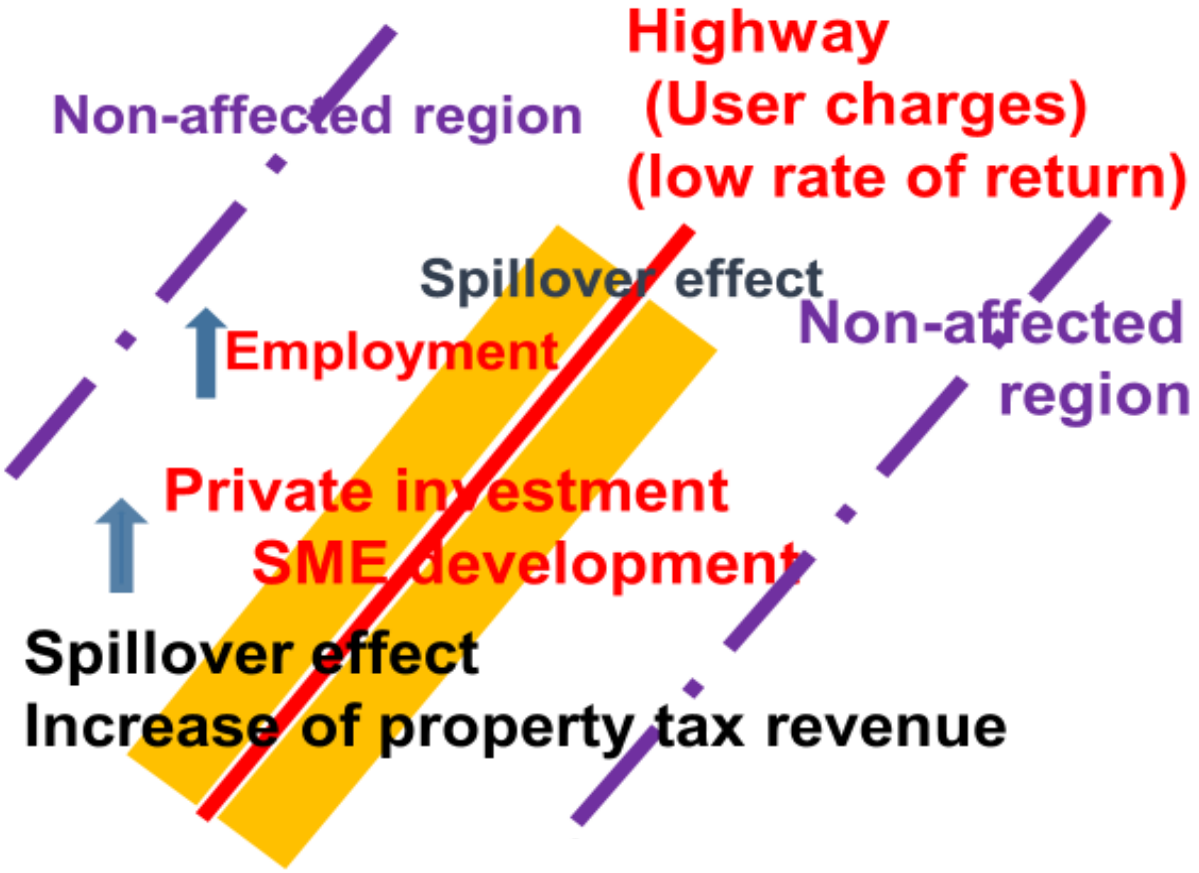
Spillover effect

→ Increase in Tax revenues

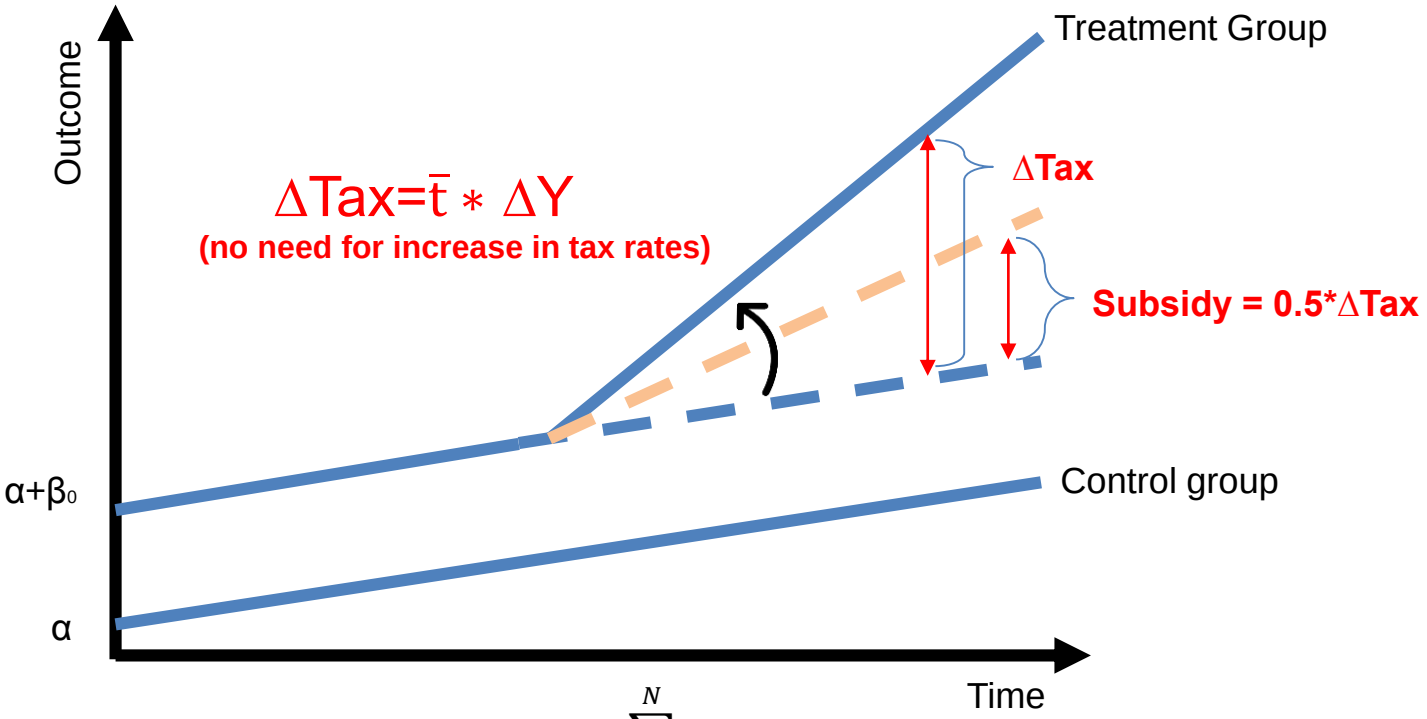
Cross-border Infrastructure

The concept of returning infrastructure revenues to investors can be applied to cross-border infrastructure, as in the case of India and Bangladesh.

Spillover Effects

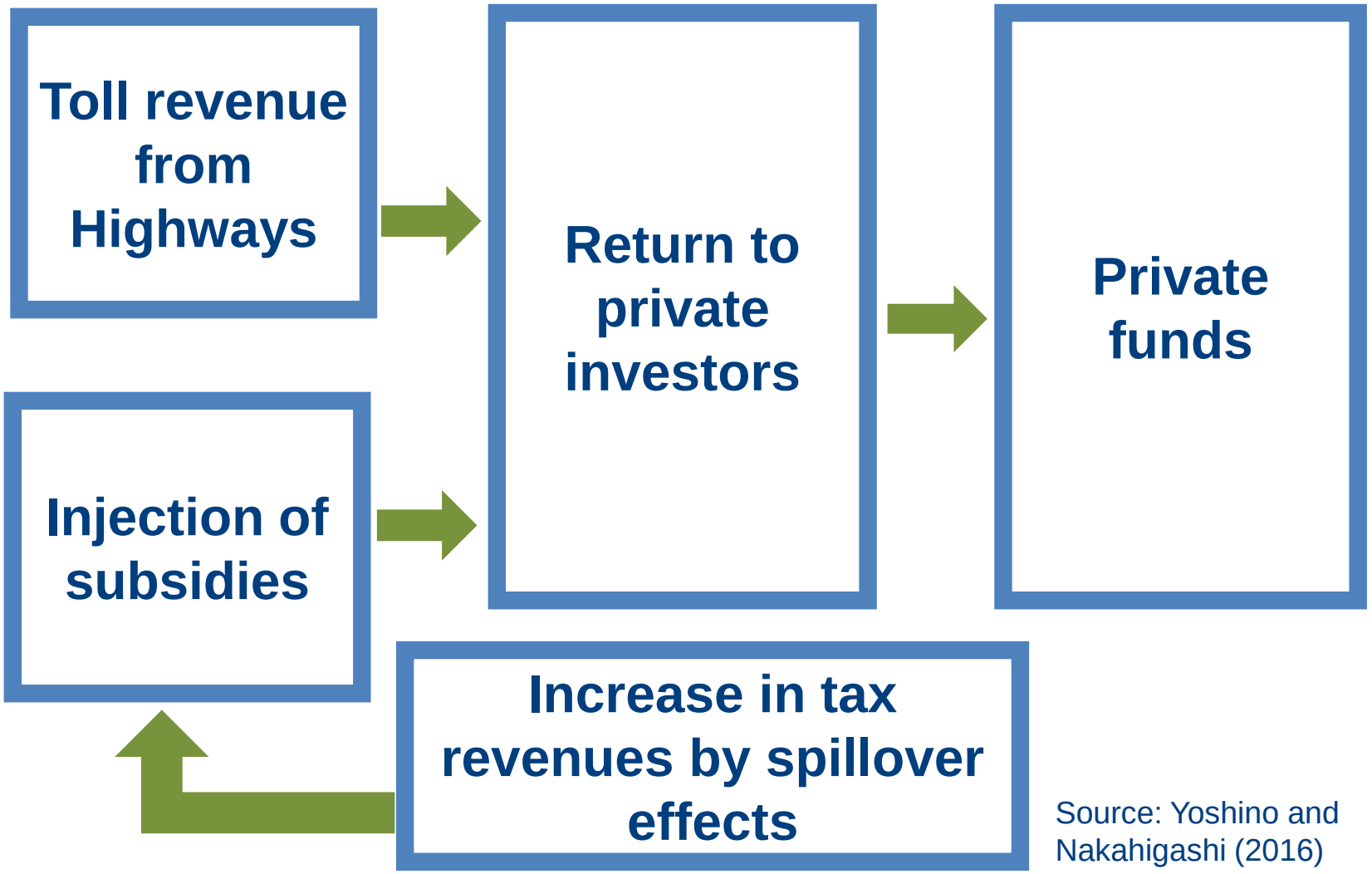


Concept of subsidy based on additional flow of tax revenue due to infrastructure



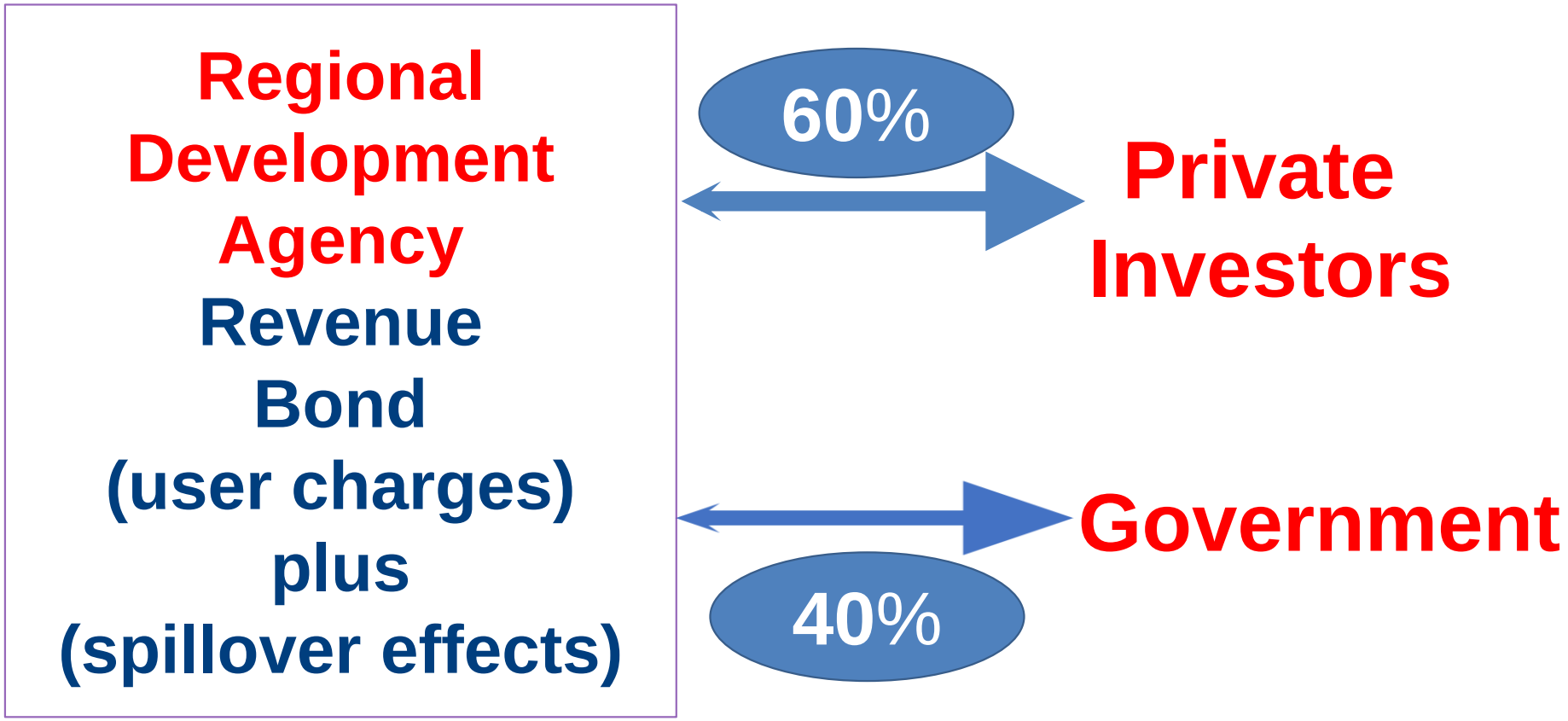
$$\text{Outcome} = \alpha + \beta_0 D_i + \sum_{t=1}^{N} \beta_0 * D_i * T_t + \varepsilon_{i,t}$$

Injection of fraction of tax revenues as subsidy



Source: Yoshino and Nakahigashi (2016)

Infrastructure Revenue Bond



Sources of Finance

Large Infrastructure Projects:

- Various maturities (10 years, 15 years, 20 years)
- Rate of return (+ spillover tax revenues → subsidies)
- Infrastructure bonds will be bought by banks, insurance companies, pension funds

Small-scale Projects (ex. Renewable energy):

- Hometown Investment Trust Funds
- Contributions collected via internet, mobile phone
- Government regulates and monitors intermediaries

Public-Private Partnership (PPP):
Give incentives to operating companies

Incentives to Operating Companies

Incentives should also be given to the operating entities (such as the railway companies and the toll way operators) and not only to the investors. Railway operators know how frequently trains should run and where train station exits should be located. Bonuses should be paid to the operating entities so that they are motivated to optimise efficiency and profitability.

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

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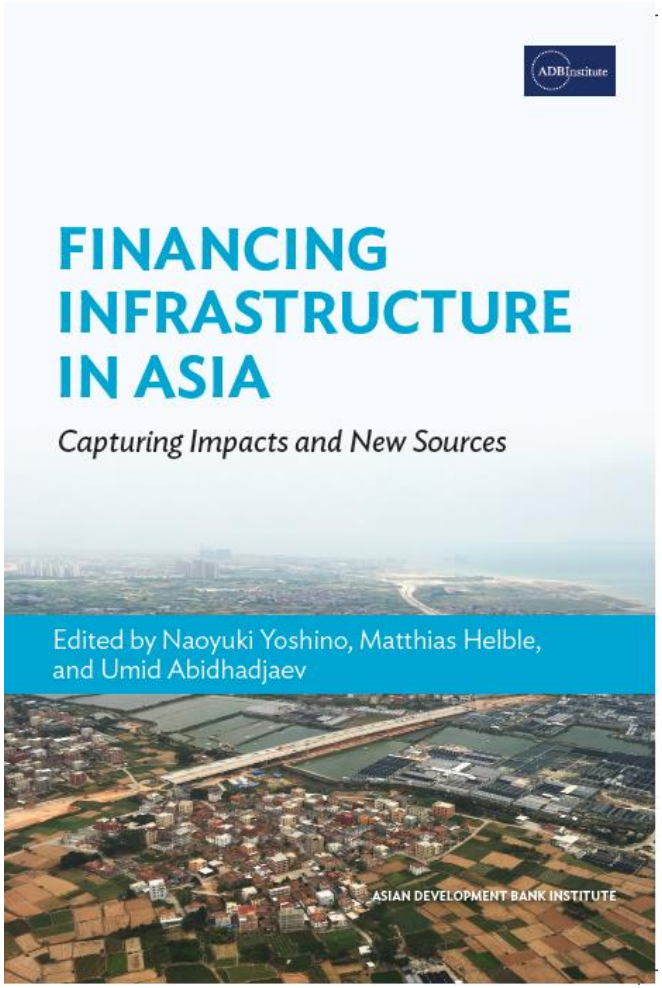

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