

Financing for Infrastructure and The Way to Increase Rate of Return

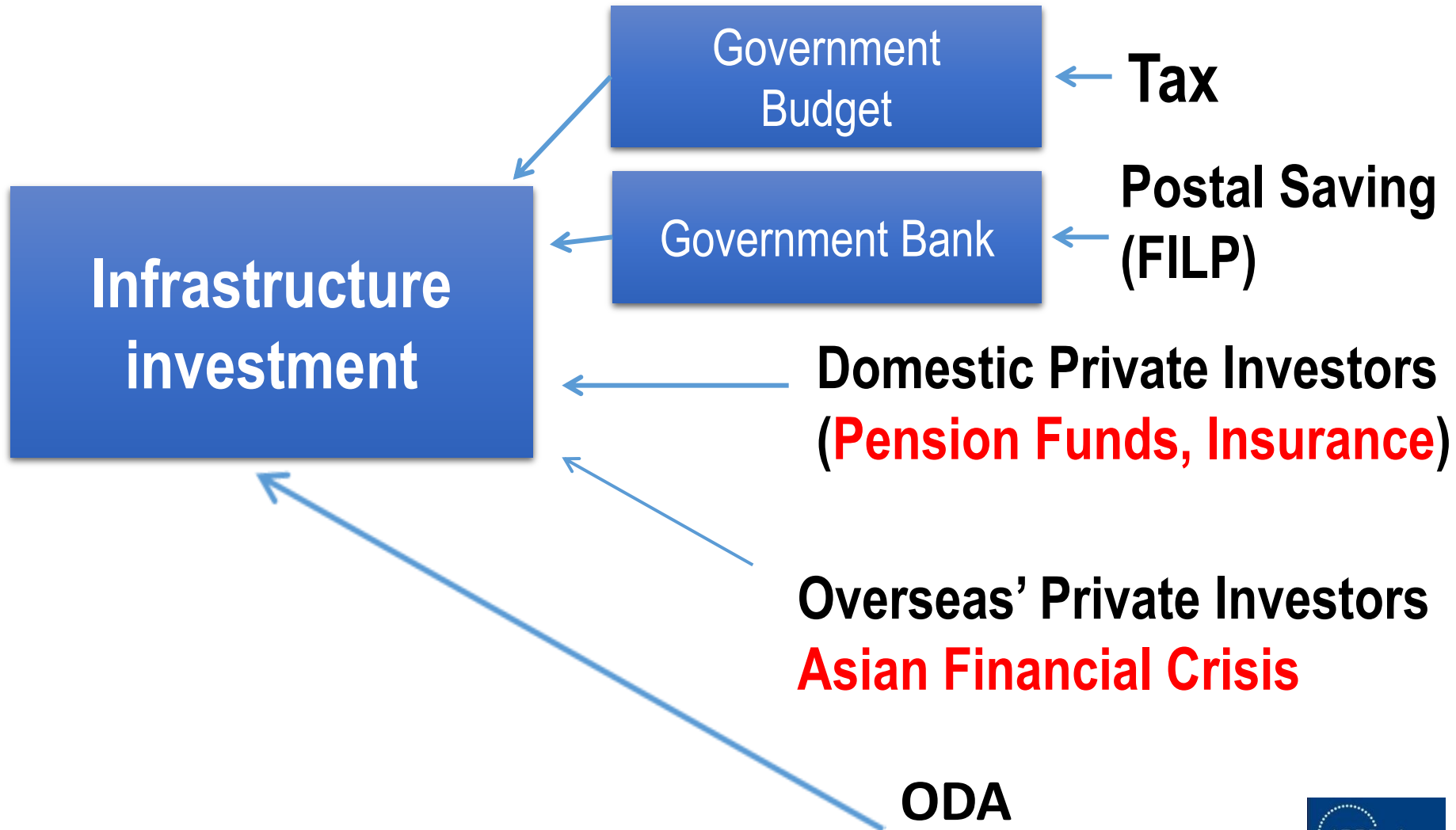
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Infrastructure Finance: Use of long term domestic savings



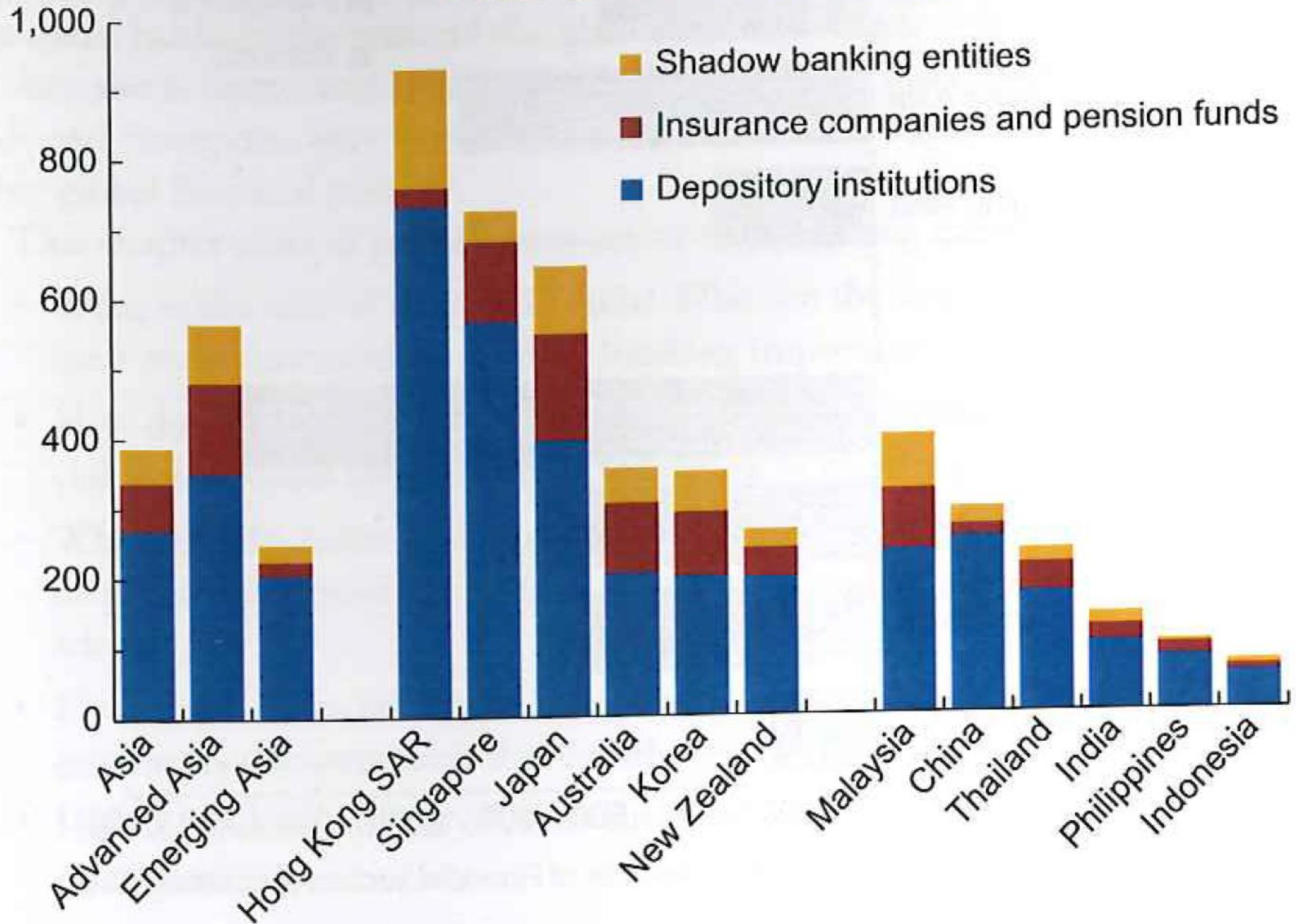
Long term and Patient investors are needed

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

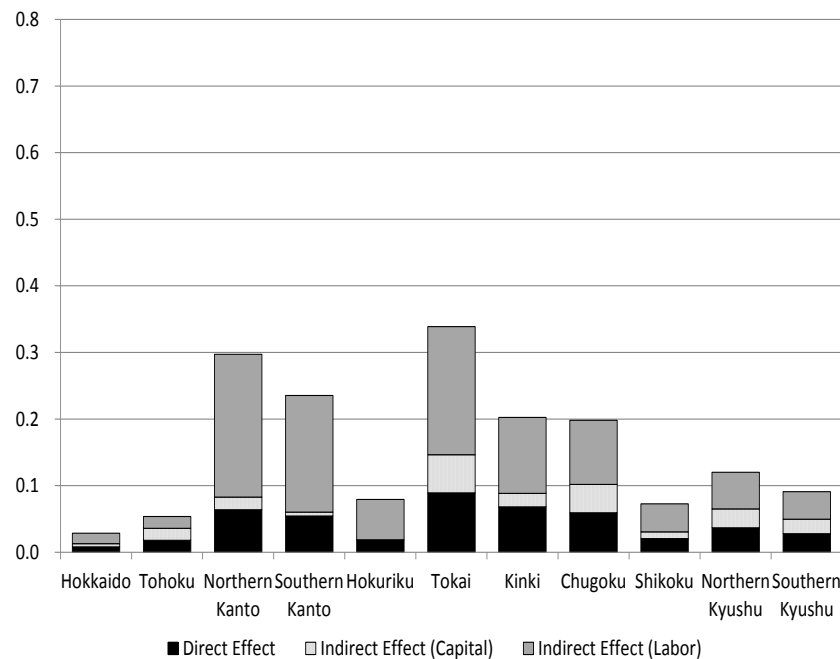
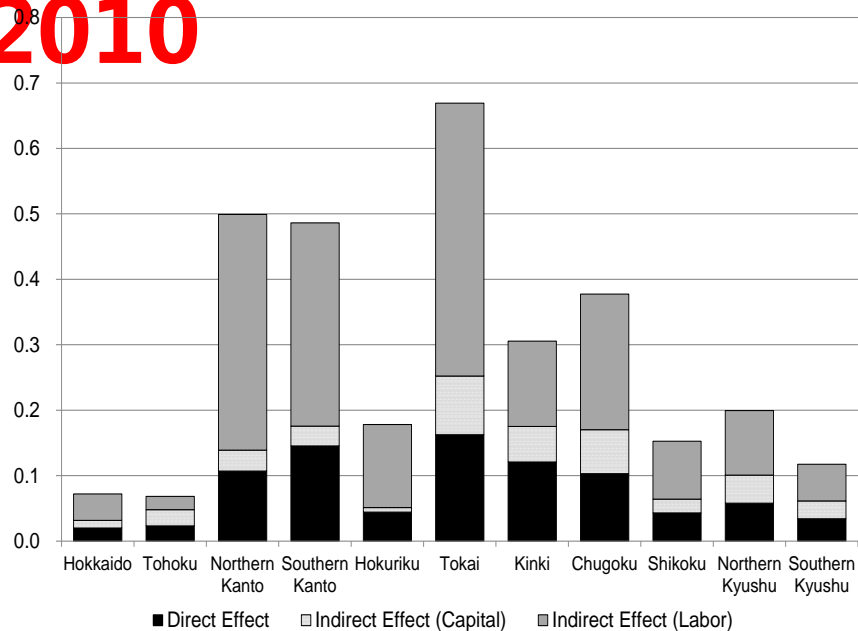


Regional Disparities of Economic Effects

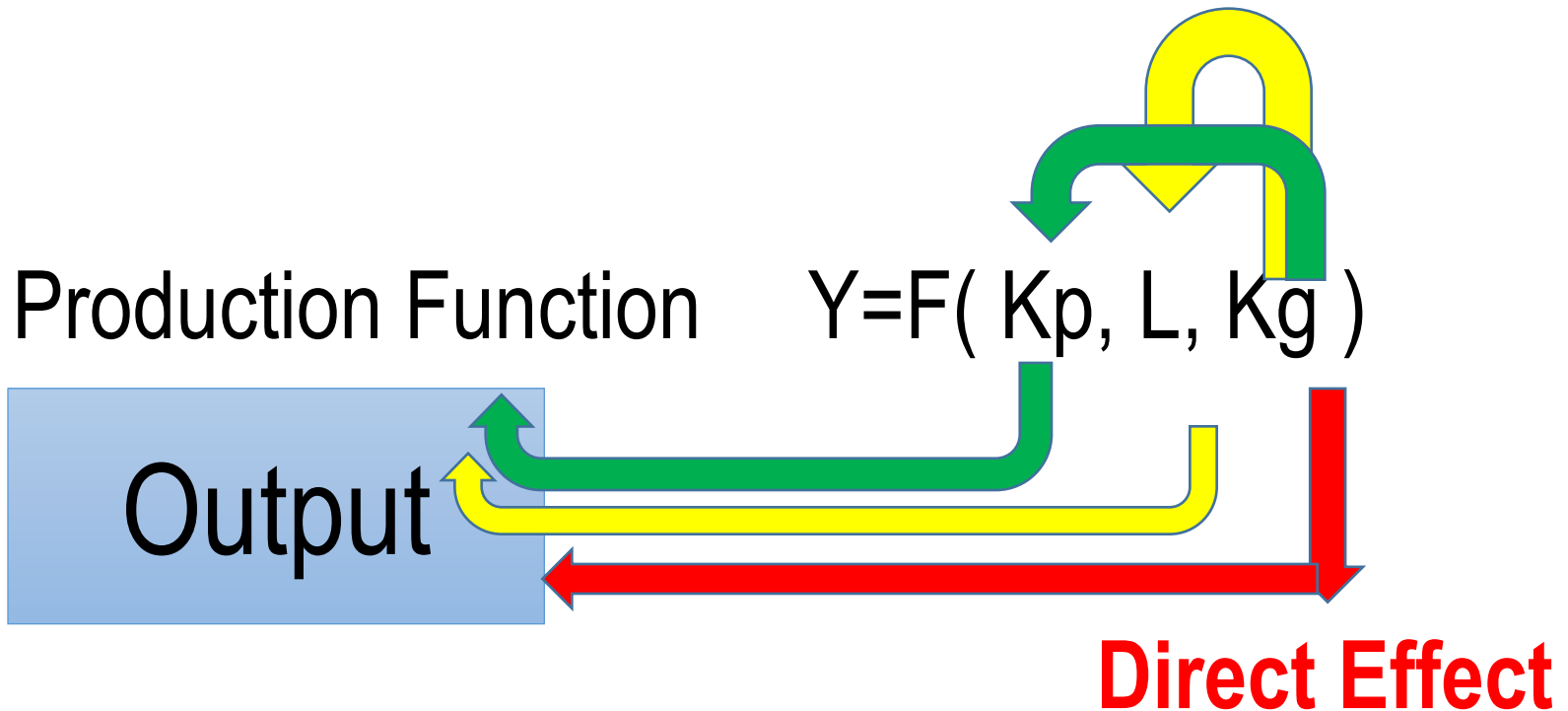
large differences in Spillover effects

1990

2010



Direct Effect and Spill-over Effects



Y = Output, K_p = private capital, L = labor
 K_g = public capital (infrastructure)

Return the spillover effects to Investors

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

$$Y = f(K_p, L, K_G) \quad (1)$$

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

In this paper, we assume the translog production function.

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

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:

$$\frac{dY}{dK_G} = \frac{\partial Y}{\partial K_G} + \frac{\partial Y}{\partial K_p} \frac{\partial K_p}{\partial K_G} + \frac{\partial Y}{\partial L} \frac{\partial L}{\partial K_G} \quad (9)$$

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.

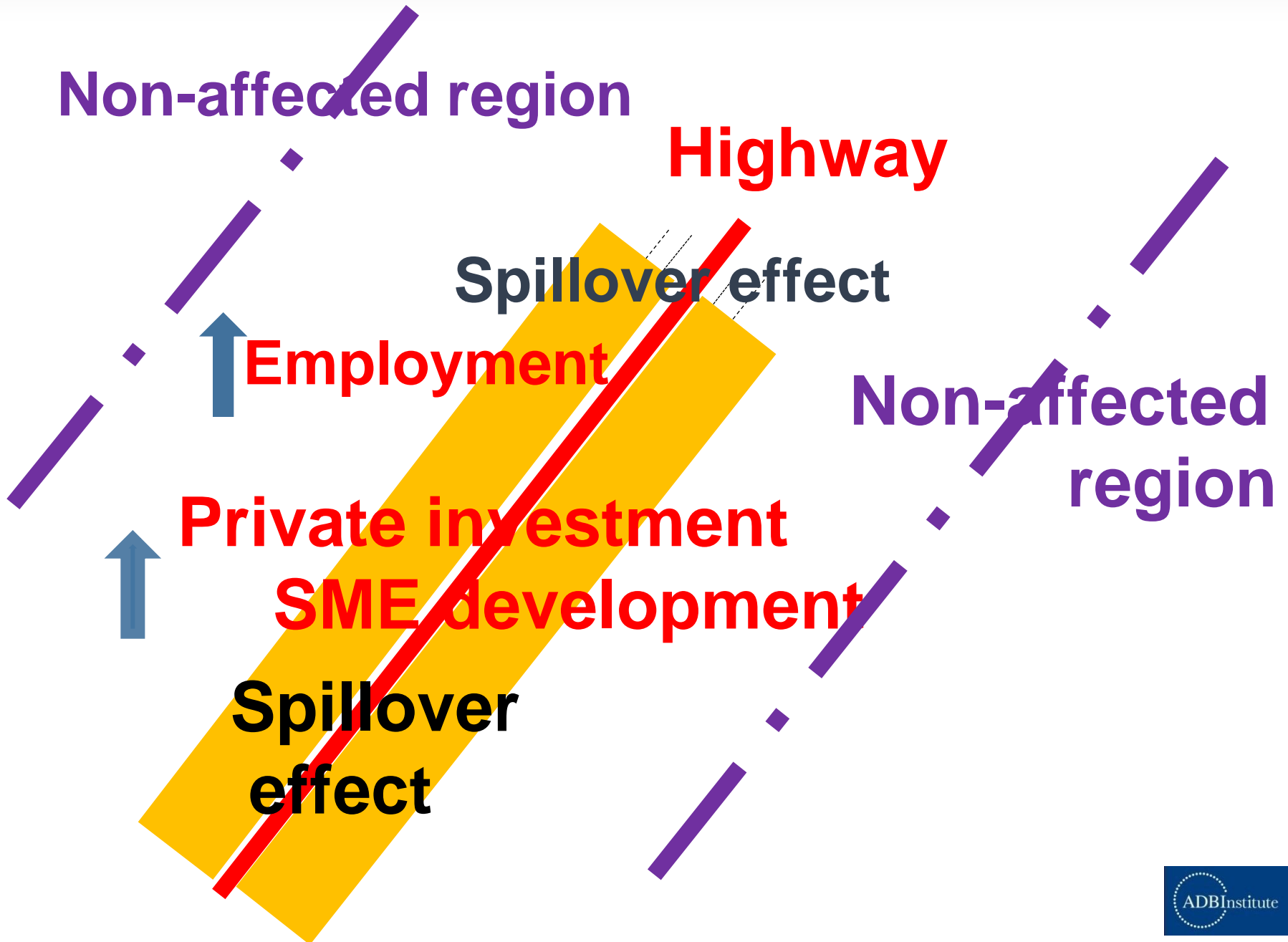
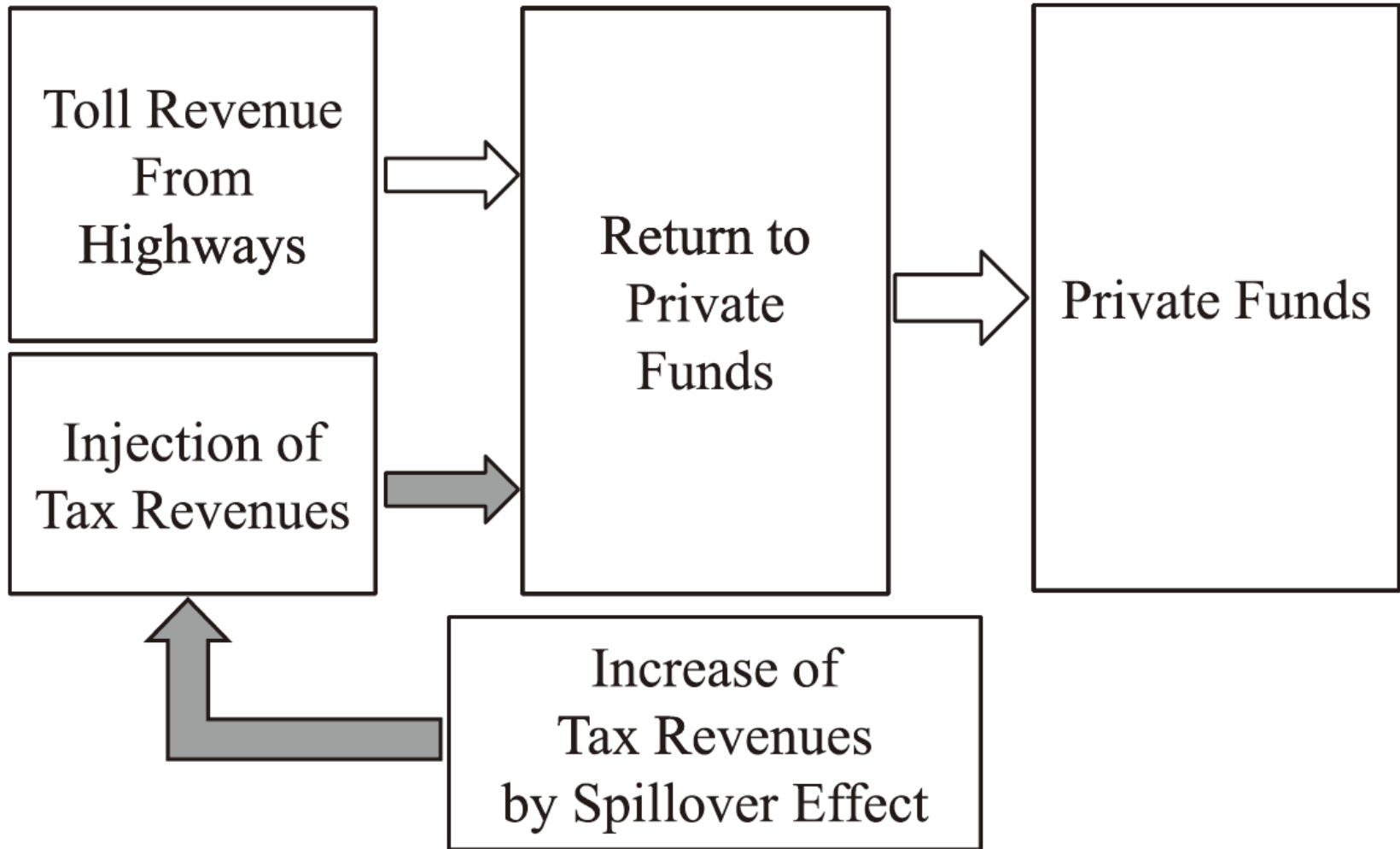


Figure 4

Injection of a fraction of tax revenues gained from spillover effect



2010	Private Capital	Public Capital	Direct Effect	Indirect Effect		20% Returned	Increment (%)
				Capital	Labor		
Manufacturing							
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		
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 Road (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.

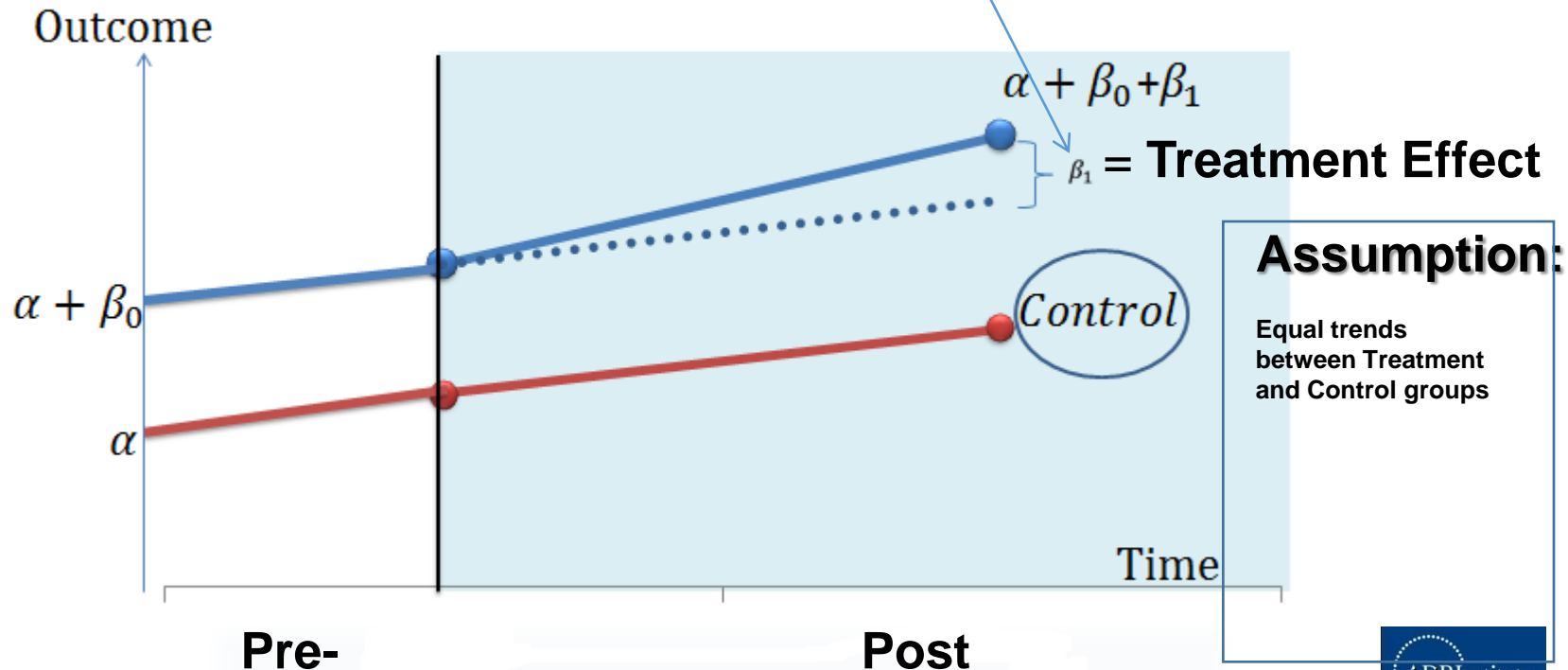


Difference-in-Difference (DiD) Analysis

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

where: $D = 1$ (Treatment group)
 $D = 0$ (Control group)

$T =$ Treatment period



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)
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

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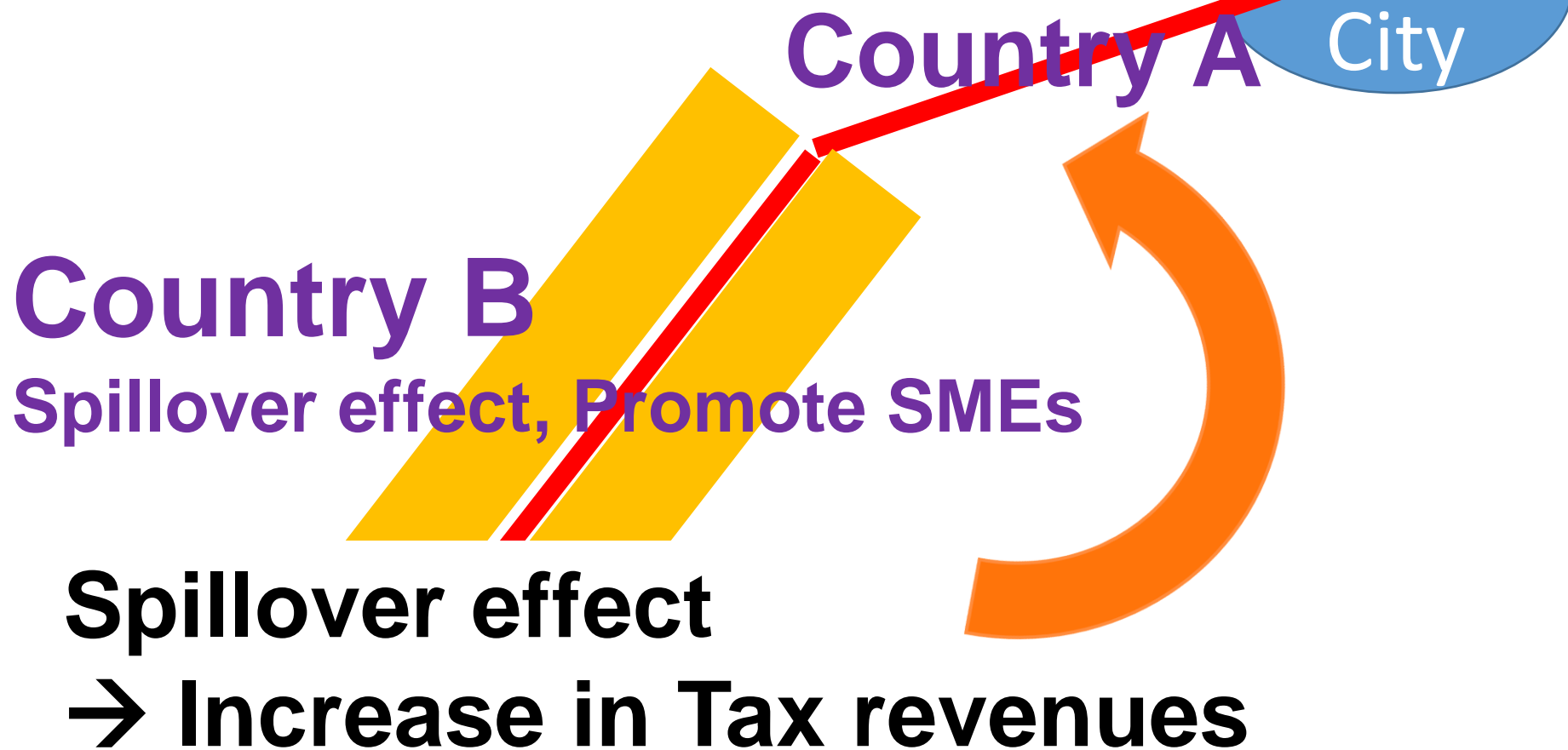
	t_{-2}	t_{-1}	t_0	t_{+1}	t_{+2}	t_{+3}	t_{+4} 以降
Lipa 市	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan 市	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas 市	490.90	622.65	652.83	637.89	599.49	742.28	1208.61

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Completion

Cross-border Infrastructure Investment

Role of Multilateral Institution

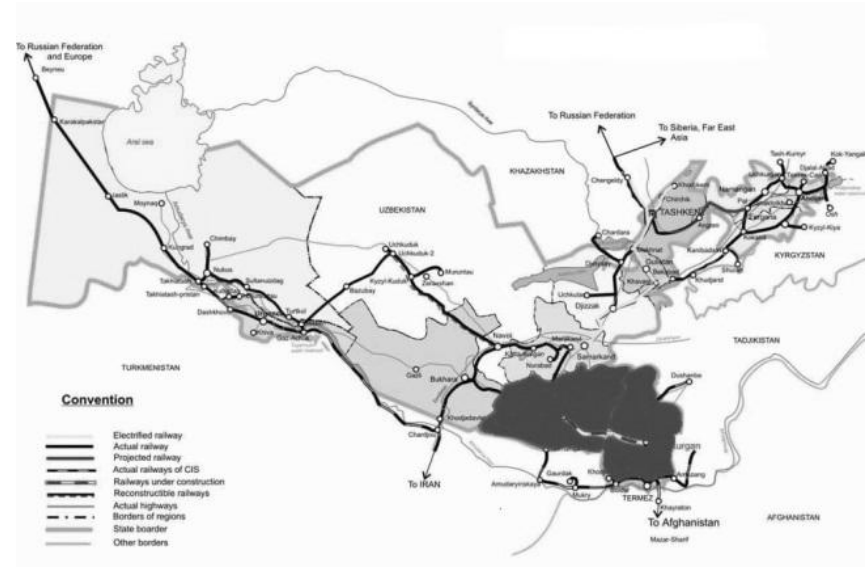


Uzbekistan Railway

GDP growth rate

$Y_{control, before}$

$Y_{treatment, before}$



Time

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

Difference-in-difference: regression

- incorporating time varying covariates

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

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

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

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

$(D_{rail} \times D_{post})_{it}$ - 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	Neighbouring 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]
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	$T(20)*\Delta Y$ (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)

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	
2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	3	3	

Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	COMPOSITION OF GROUPS	
Treatment2	-4772.54 [-0.2]					Group2	Group5
Number of tax payers	5.8952514* [1.95]	5.8957045* [1.95]	5.896112* [1.95]	5.8953585* [1.95]	5.8629645* [1.91]	Kagoshima Kumamoto Fukuoka	Kagoshima Kumamoto Fukuoka
Treatment3		-15947.8 [-0.87]				Group3	Oita Miyazaki
Treatment5			-13250.4 [-1.06]			Kagoshima Kumamoto Fukuoka	
Treatment7				-6883.09 [-0.7]		Group7	GroupCon
TreatmentCon					-28030.8 [-0.65]	Kagoshima Kumamoto Fukuoka Oita	Kagoshima Kumamoto Fukuoka Osaka Hyogo
Constant	-665679 [-1.35]	-665418 [-1.35]	-665323 [-1.35]	-665358 [-1.35]	-658553 [-1.32]	Miyazaki	Okayama
N	799	799	799	799	799	Saga	Hiroshima
R2	0.269215	0.269281	0.269291	0.269241	0.269779	Nagasaki	Yamaguchi
F	1.934589	2.106448	2.074548	2.100607	8.497174		

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

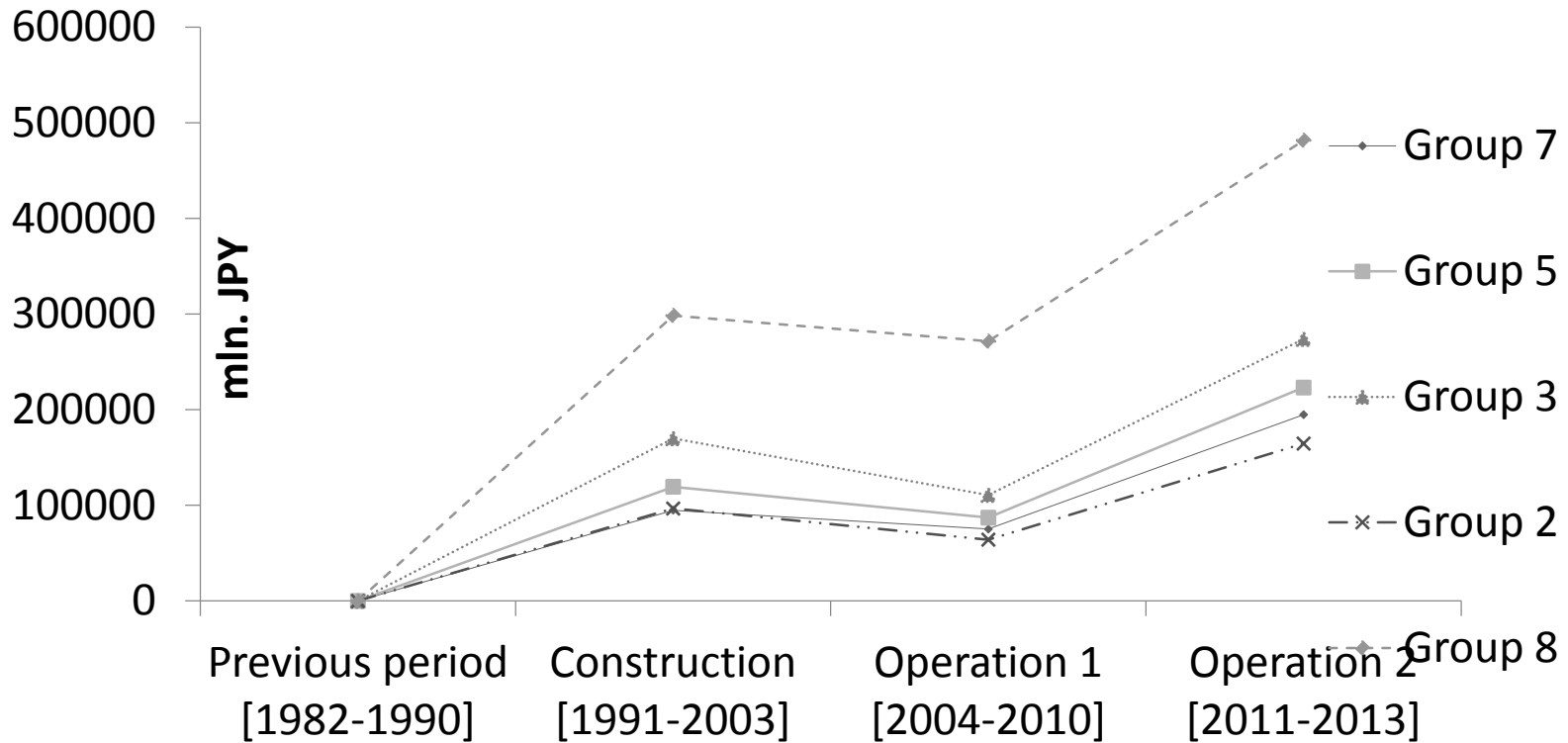
Impact of Kyushu Shinkansen Rail on CORPORATE TAX revenue during 2nd PHASE OF OPERATION period {2011-2013} , mln. JPY (adjusted for CPI, base 1982)

1	1	1	1	1	1	1	1	1	1	1	1	19	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
9	9	9	9	9	9	9	9	9	9	9	9	94	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	3	4	5	6	7	8	9	0	1	2	3	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	2	2	2

	REGRESSION RESULTS						COMPOSITION OF GROUPS	
Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Group2	Group5	
Treatment2	72330.012** [2.2]					Kagoshima Kumamoto	Kagoshima Kumamoto	
Number of tax payers	5.5277056*** [3.13]	5.5585431*** [3.14]	5.558603*** [3.14]	5.5706545*** [3.14]	5.9640287*** [3.07]	Group3 Kagoshima Kumamoto Fukuoka	Oita Miyazaki	
Treatment3		104664.34* [2]						
Treatment5			82729.673** [2.1]					
Treatment7				80998.365** [2.34]			GroupCon Kagoshima	
TreatmentCon					179632 [1.58]	Group7 Kagoshima Kumamoto Fukuoka Oita	Kumamoto Fukuoka Osaka Hyogo	
Constant	-568133.98** [-2.07]	-573747.28** [-2.08]	-574245.87** [-2.08]	-576867.56** [-2.09]	-642138.87** [-2.1]		Okayama Hiroshima Yamaguchi	
N	611	611	611	611	611	Miyazaki		
R2	0.350653	0.352058	0.352144	0.352874	0.364088	Saga		
F	5.062509	5.486197	5.351791	5.431088	16.55518	Nagasaki		

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



Public-Private Partnership (PPP)

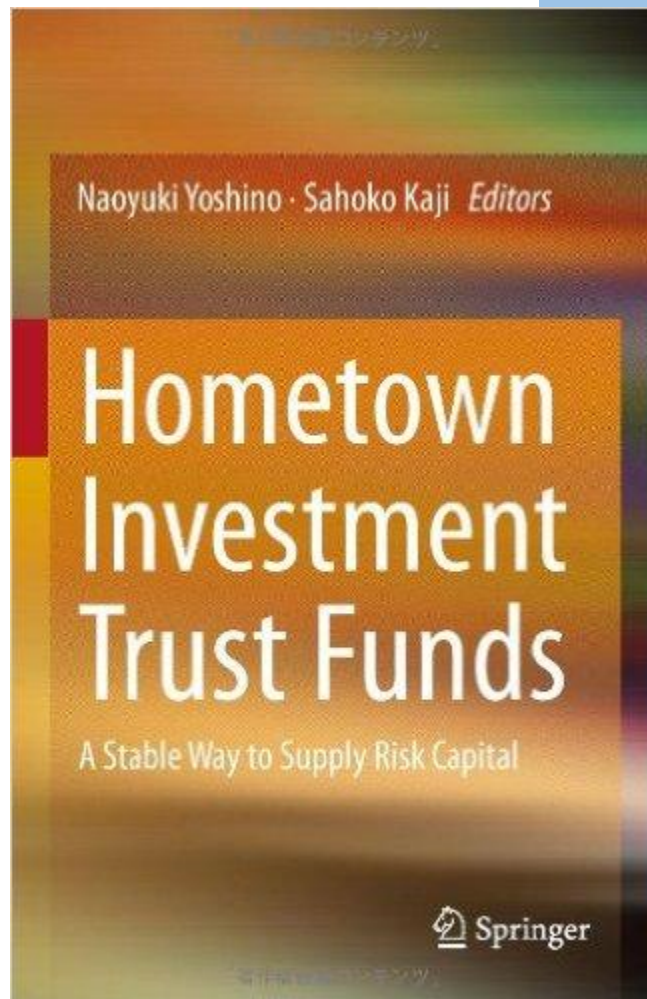
Give incentives to operating entity

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

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すべてを失い再起を断念しようになった時の

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 Philippines”, 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.