

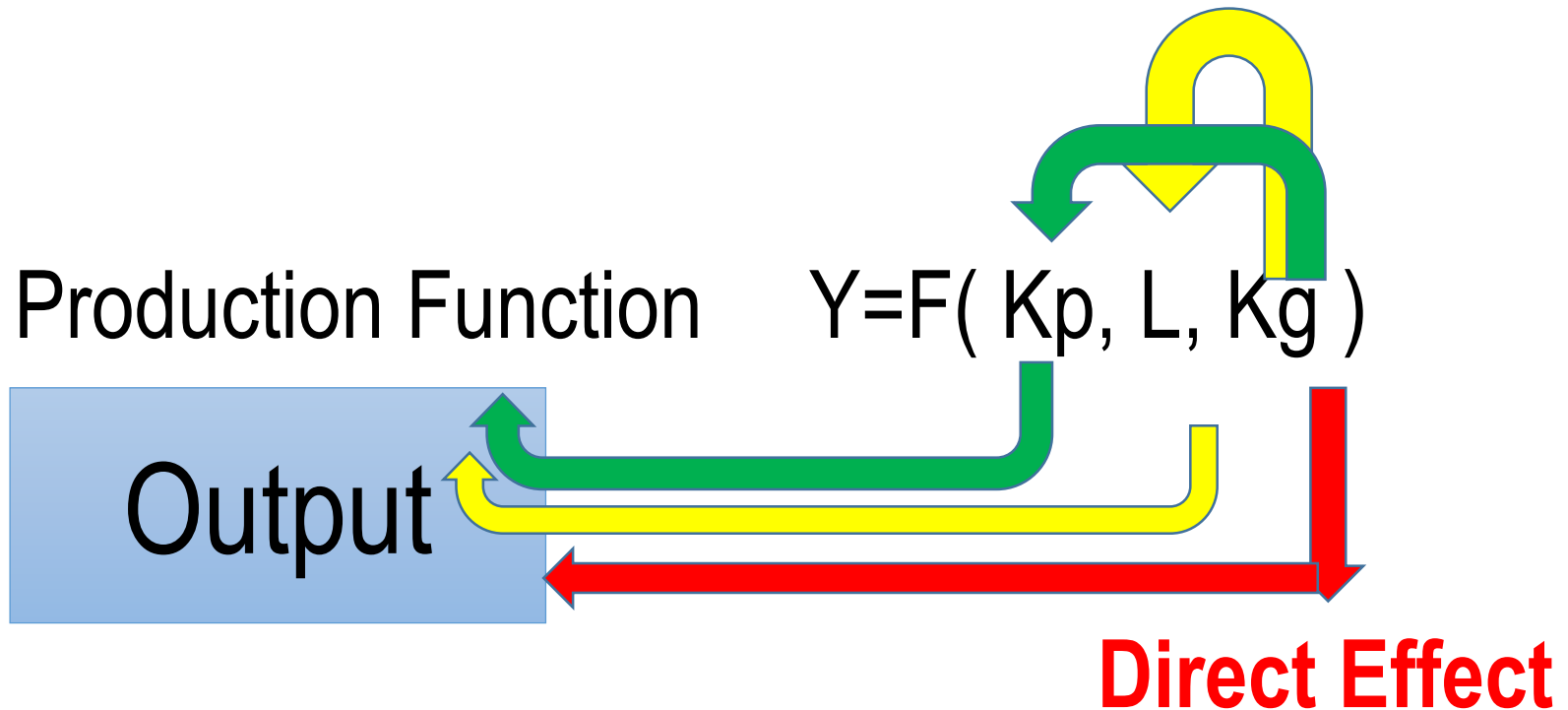
Economic Impact of Water Infrastructure: Proposal of Evaluation

Naoyuki Yoshino

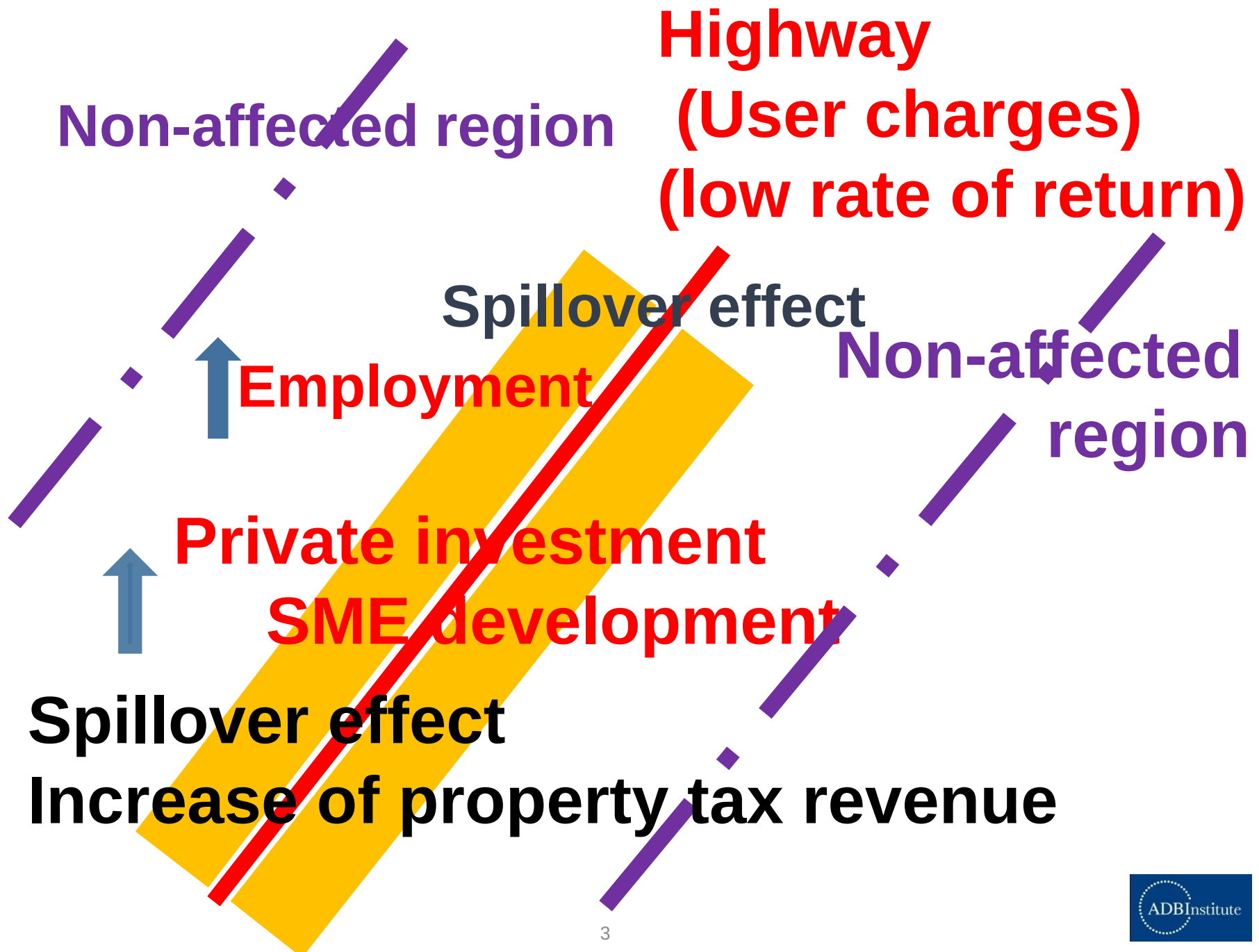
**Dean, Asian Development Bank Institute
(ADBI)**

Professor Emeritus of Keio University
nyoshino@adbi.org

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.

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

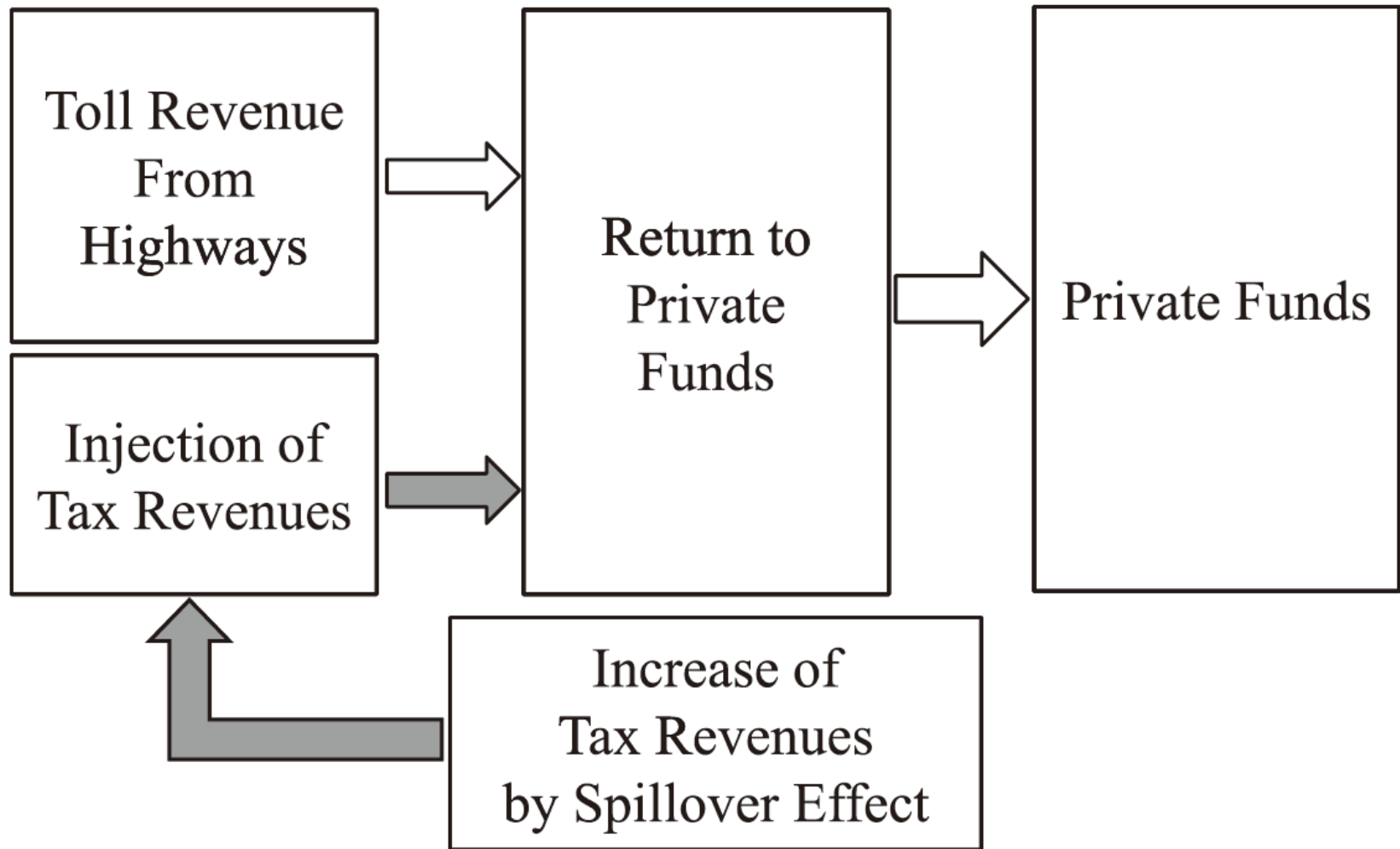
Assuming the production function represented by equation (1), and that factor prices and infrastructure are given for producers in the private sector, the effect of infrastructure on productivity is expressed as:

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

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



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 Analysis)

- 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.

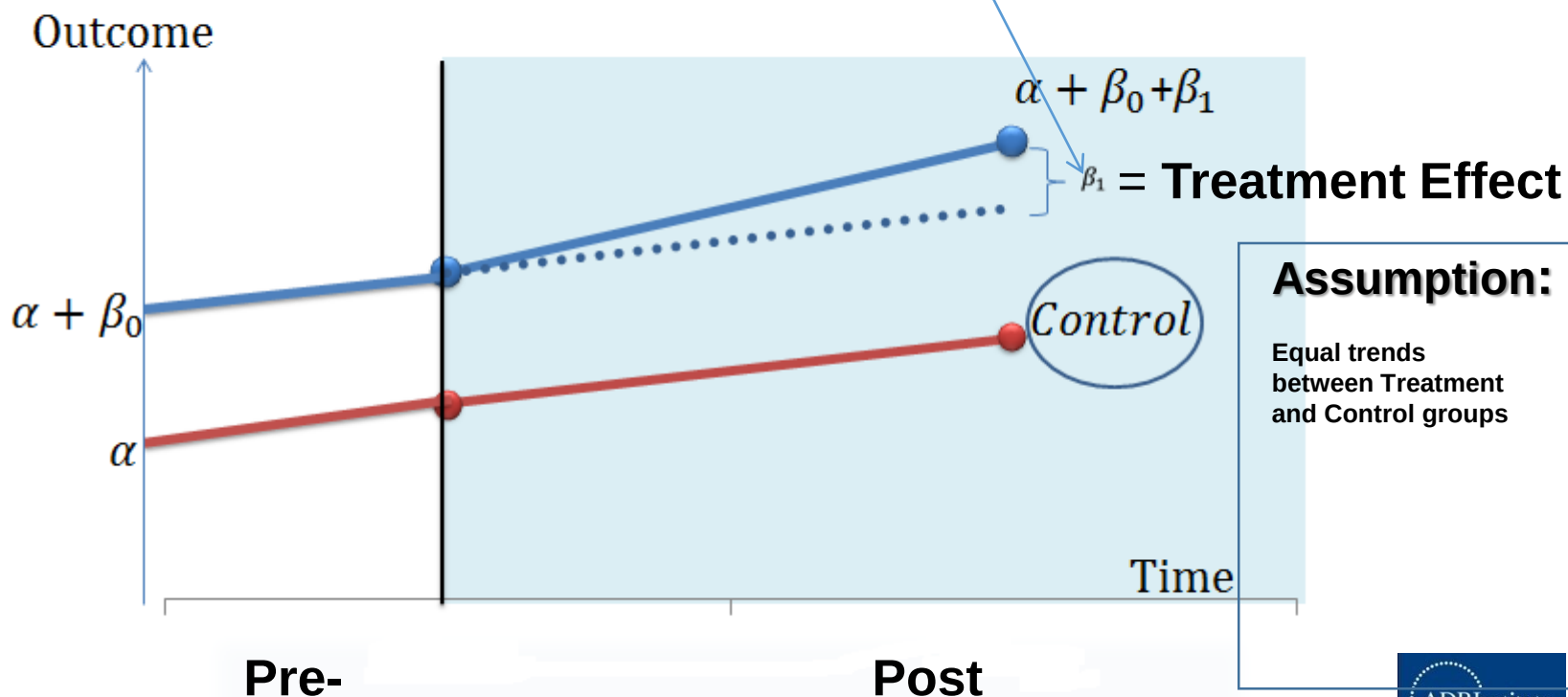


Difference-in-Difference (DiD) Analysis

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

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

$T =$ Treatment period



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

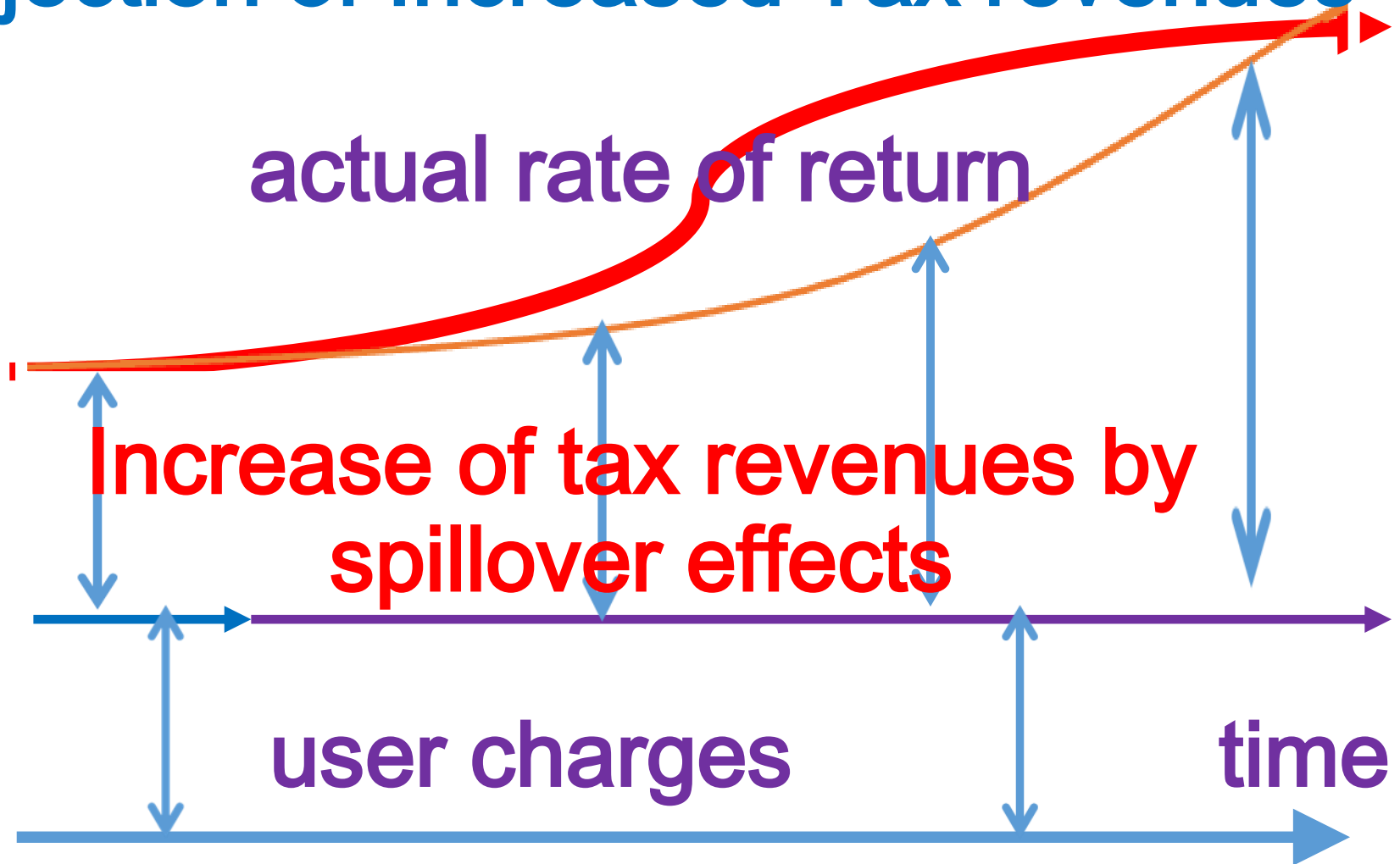
(単位：100 万ペソ)

	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

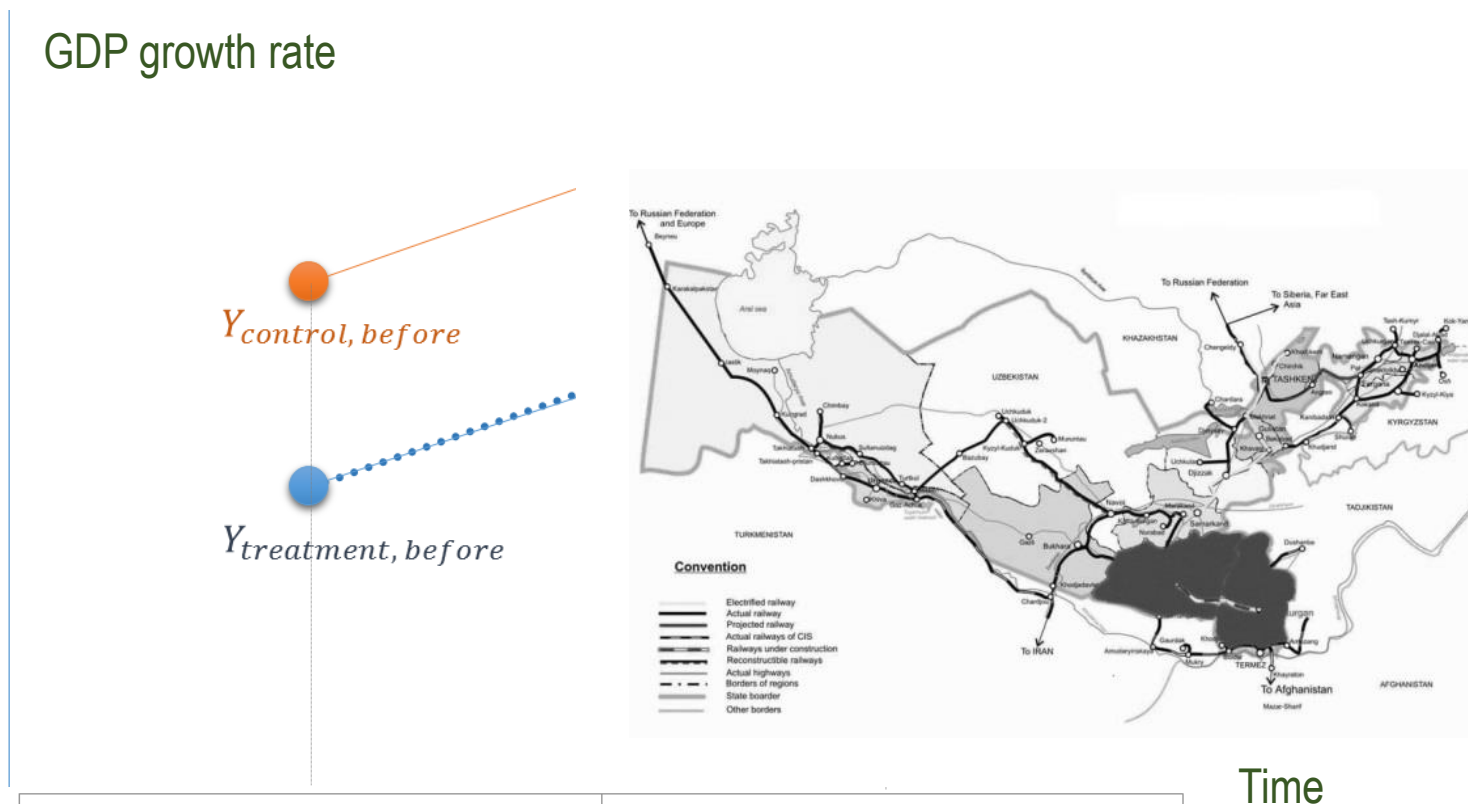
(出所) Yoshino and Pontines (2015)より筆者作成

Completion

Injection of Increased Tax revenues



Uzbekistan Railway: Connectivity is important



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

GDP



	GDP	Term	Connectivity spillover effect	Regional spillover effect	Neighboring 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]
	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
THE 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
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
8	8	8	8	8	8	8	8	8	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

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

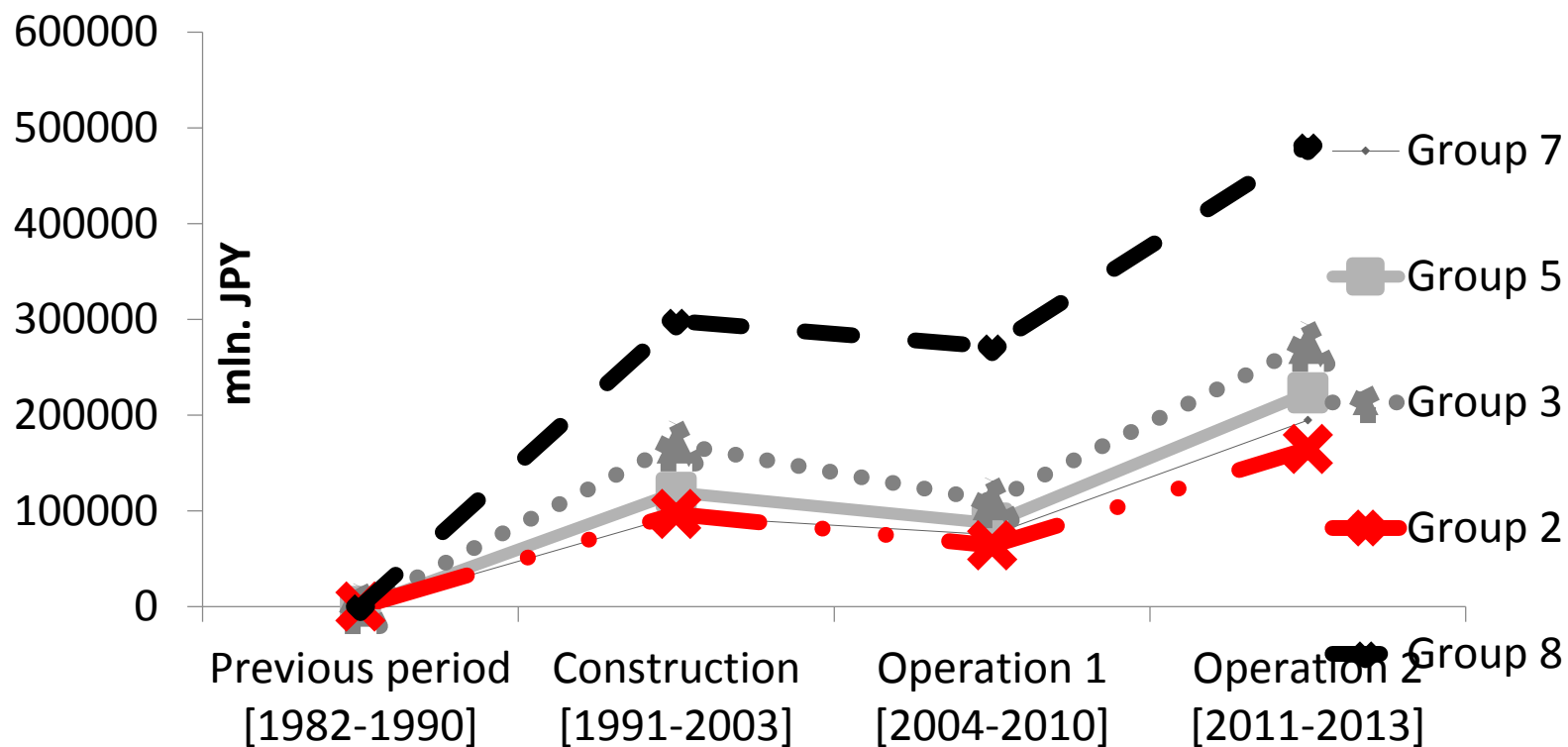
**Impact of Kyushu Shinkansen Rail on
E TAX revenue during 2nd PHASE OF OPERATION period
{2011-2013} , mln. JPY (adjusted for CPI, base 1982)**

1	1	1	1	1	1	1	1	1	1	1	1	1	19	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
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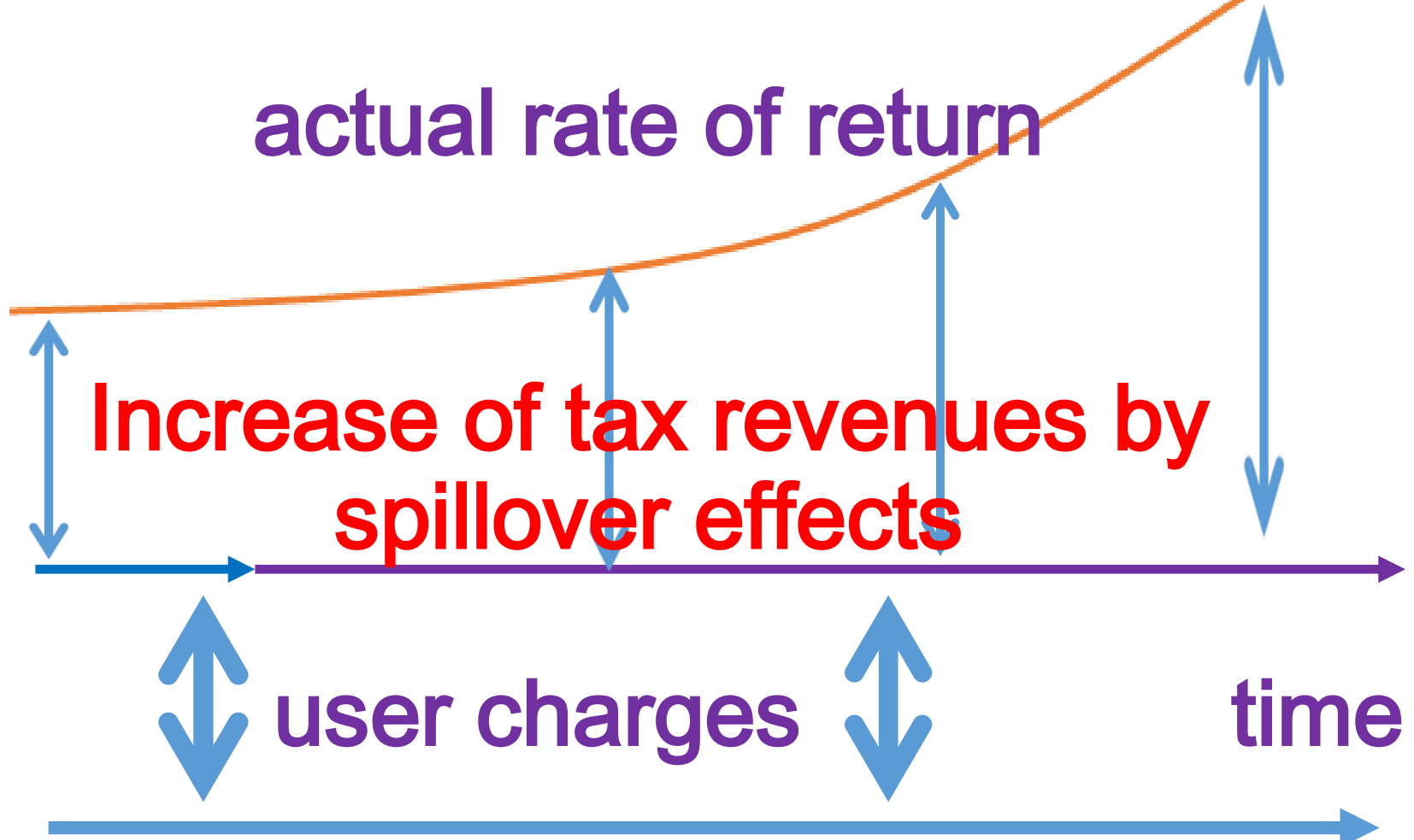
						COMPOSITION OF GROUPS	
Variable	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Group2	Group5
Treatment2	72330.012** [2.2]					Kagoshima Kumamoto	Kagoshima Kumamoto
Number of tax payers	5.5277056*** [3.13]	5.5585431*** [3.14]	5.558603*** [3.14]	5.5706545*** [3.14]	5.9640287*** [3.07]	Group3 Kagoshima Kumamoto Fukuoka	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]	Miyazaki	Okayama
N	611	611	611	611	611	Saga	Hiroshima
R2	0.350653	0.352058	0.352144	0.352874	0.364088	Nagasaki	Yamaguchi
F	5.062509	5.486197	5.351791	5.431088	16.55518		

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



Injection of Increased Tax revenues



Estimation of water related Risk

1. Negative Effects of Flood, Typhoon etc.

How to measure negative impacts?

(1) <Direct effects>

Changes in Production of Agricultural products

Changes in Income tax revenues

Changes in Corporate tax revenues

Changes in Sales → Consumption tax

(2) <Spillover effects>

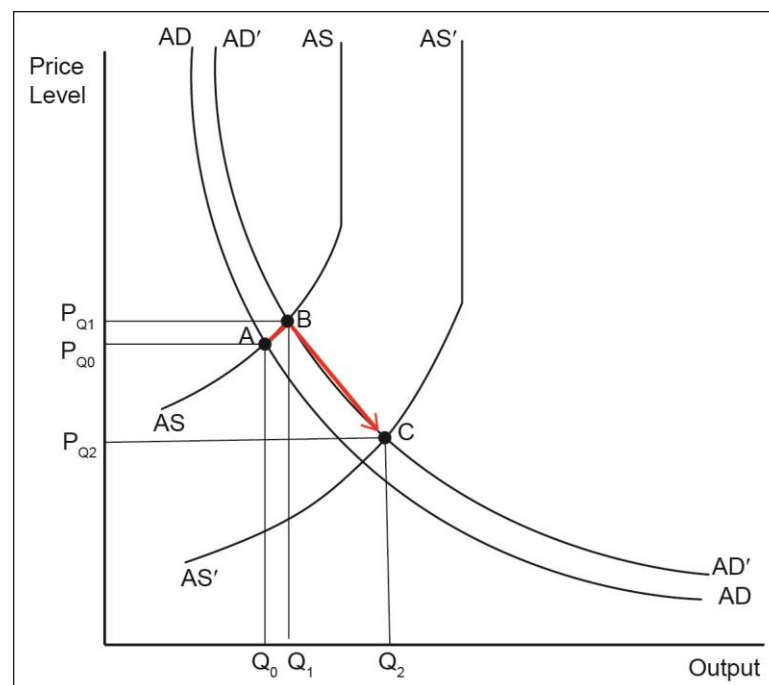
Decline in supply of food and other goods

→ Increase in prices of goods and services

Estimation of Indirect Effects of Disaster to Macro economy

(3) Impact of rising price of commodities

- Households' consumption declines
- Increase of general price level



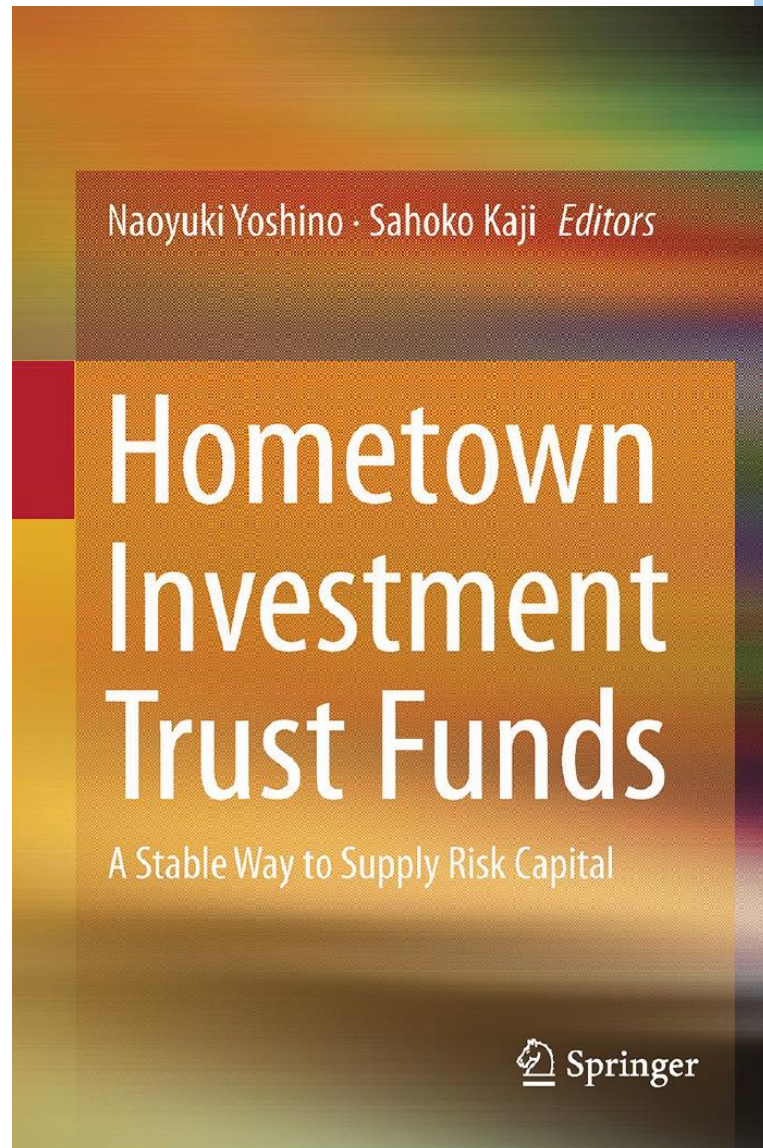
Economic Effects of Dam Construction

- 1, Stable supply of clean water
- 2, Increase of property value (Ex. Manila water)
changes in property prices
- 3, Industries come to the region
corporate tax revenues, increase in Sales
- 4, Clean water improves health condition
number of patients
- 5, Increase in Tax revenues will tell the impact
Income tax revenues

Case Study of Natural Disaster

- 1, Japanese Dam construction**
- 2, Thailand flood case**
- 3, Philippines typhoon case**
- 4, Difference in difference method
and Macro economic data**
- 5, Estimation of the negative impact**
- 6, Compare with construction costs**

Possible Solutions by use of community funds



Hometown Investment

A Stable Way to Supply Risk Capital

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

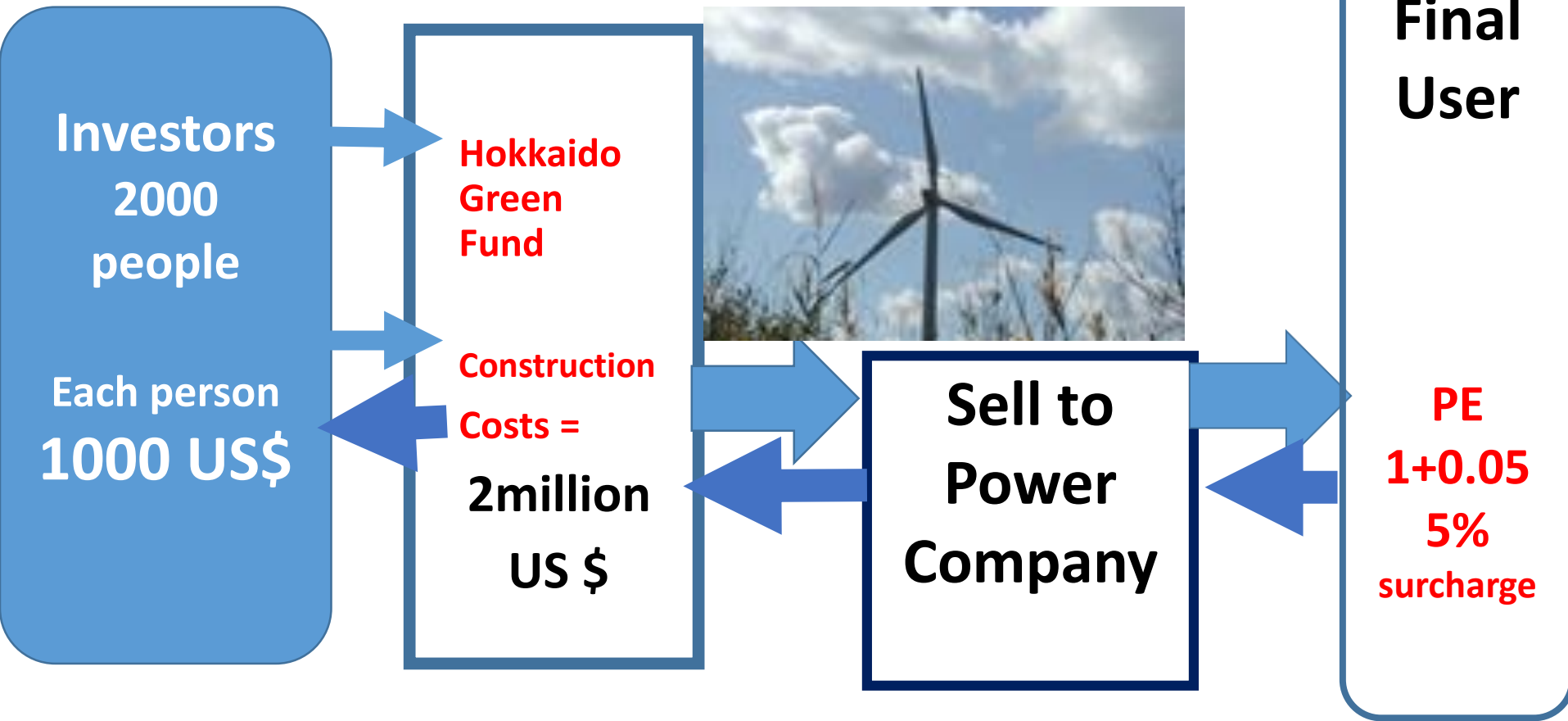
Revitalization of Tsukubane Hydro Power (Nara state)

250 investors, total 525 thousand US dollars, Japan

Original
Dam was
constructed
more than
100 years
ago



Private Financial Scheme of Wind Power Collected by Individuals (started in 2001-9)



Scheme of Financing Power Panels

Local Government
Subsidies (2/3)



Private Individuals

Hometown Trust Funds

1000 US\$ — 5000 US \$

377

Solar power
plants



Power
Company



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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)

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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.

Infrastructure Finance

Infrastructure investment

**Increase
Rate of return
By injecting
Incremental
Tax revenues
Obtained by
Spillover effects**

Government
Budget

← Tax

Government

← Postal Saving
Post Insurance

Viability Gap Fund

Domestic Private Investors
(**Pension Funds, Insurance**)

Overseas' **Pension investors**

← ADB

Viability Gap Fund and Government Burden

Investors only benefit

