Economic Effects of Transport Infrastructure and The Way to Increase Rate of Return

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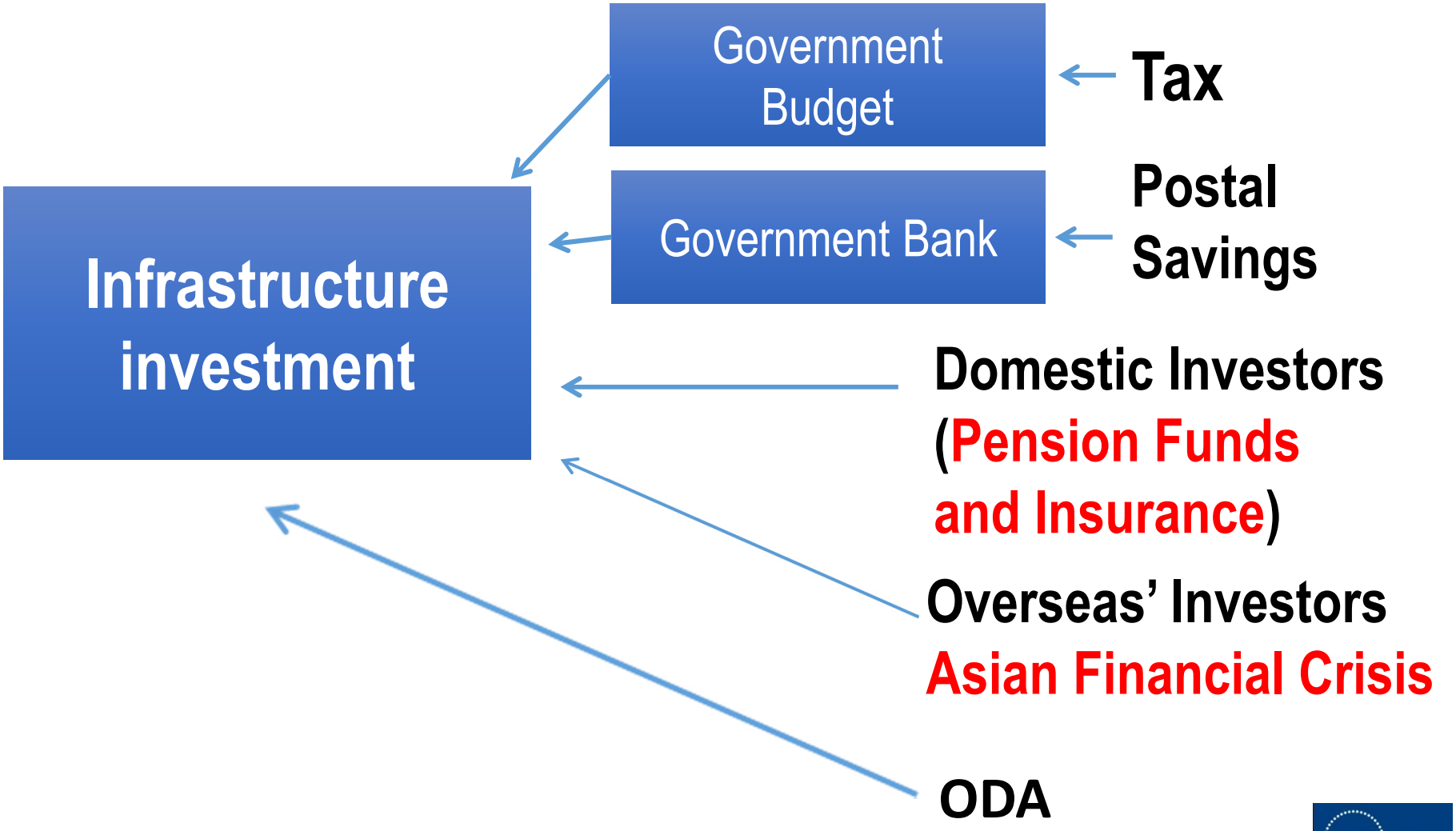
Infrastructure Finance: Use of long term domestic savings

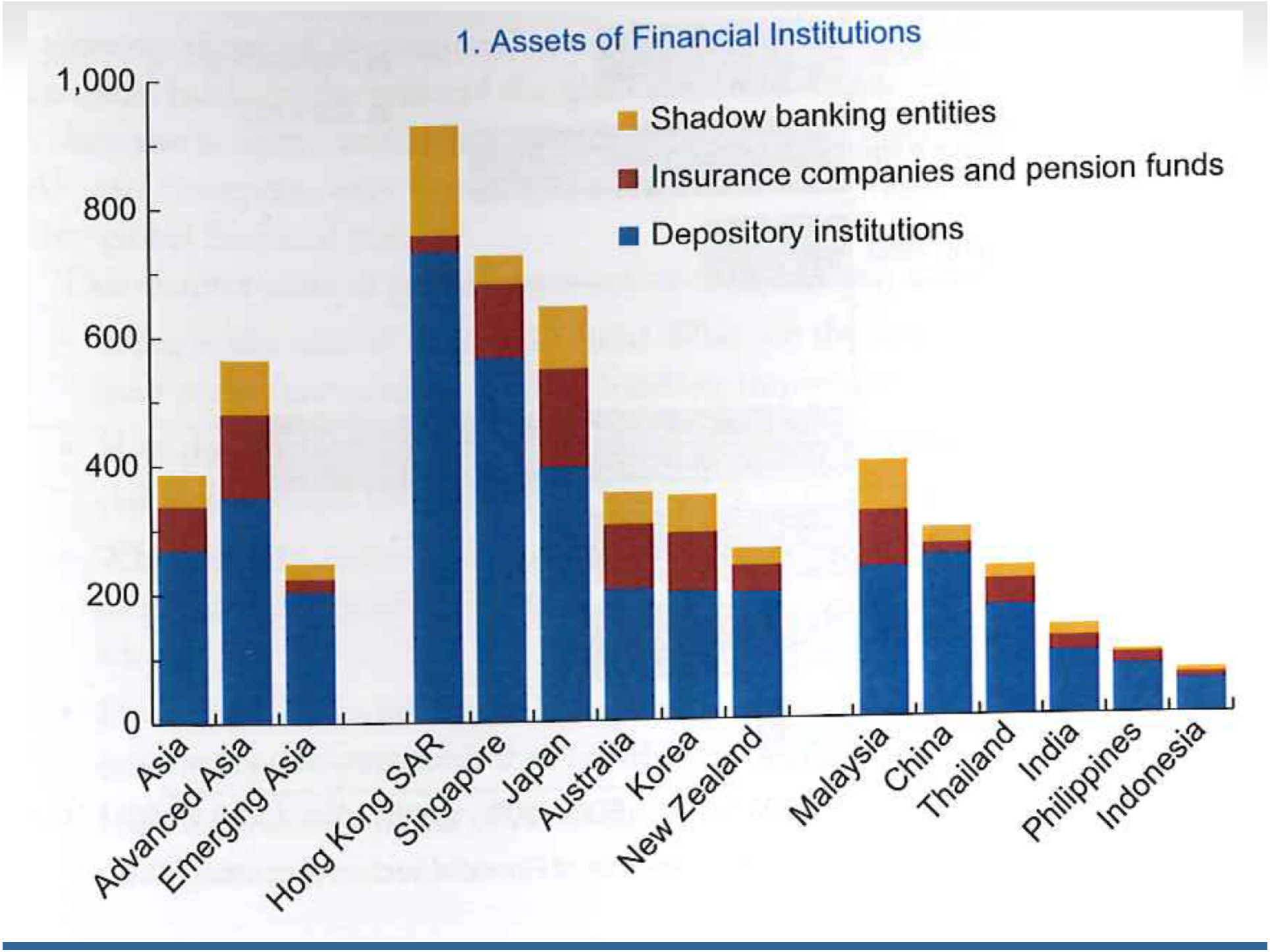


Long term and Patient investors are needed

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

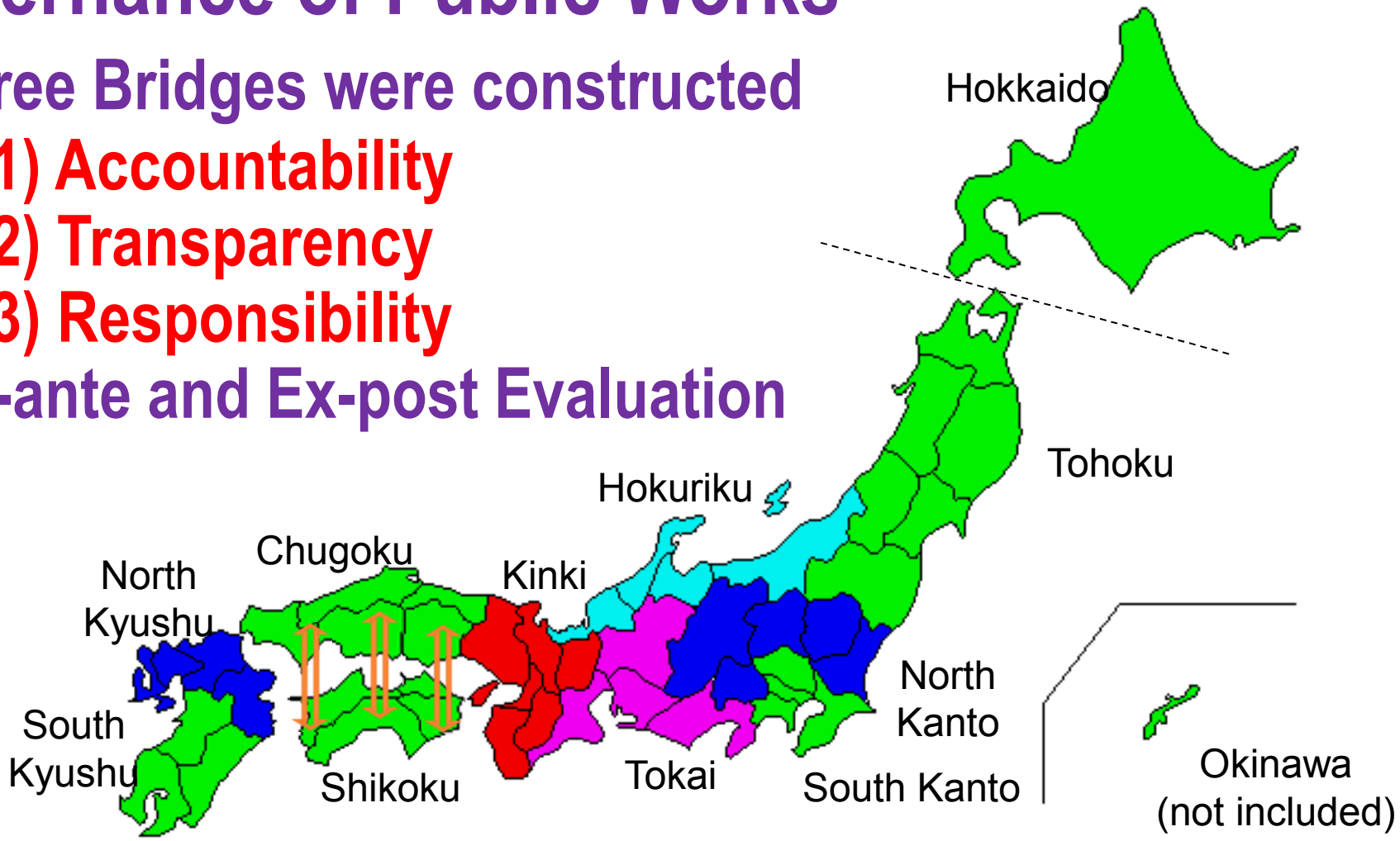

1. Assets of Financial Institutions
1,000
800
600
400
200
0
Shadow banking entities
Insurance companies and pension funds
Depository institutions
Asia
Advanced Asia
Emerging Asia
Hong Kong SAR
Singapore
Japan
Australia
Korea
New Zealand
Malaysia
China
Thailand
India
Philippines
Indonesia

Map of Japan
Governance of Public Works

Three Bridges were constructed

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

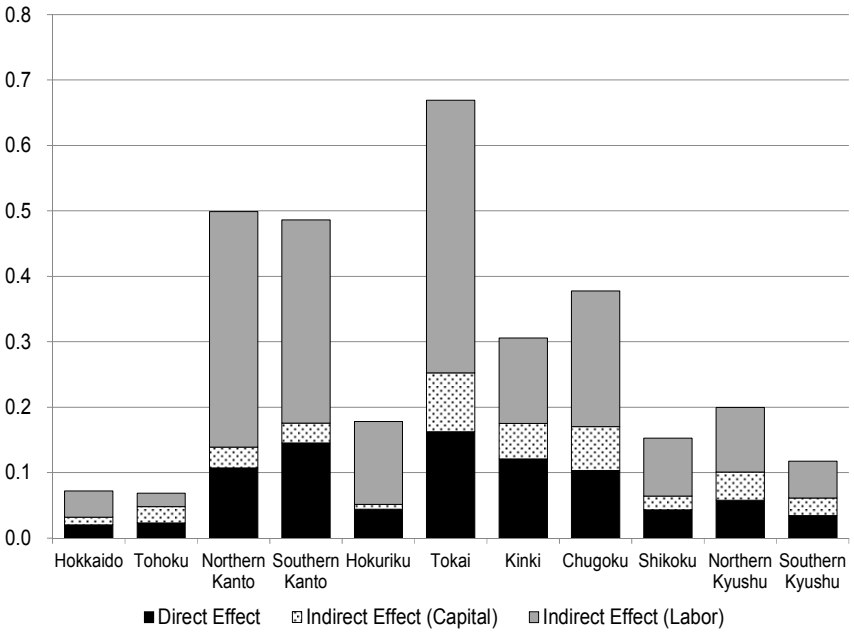
Ex-ante and Ex-post Evaluation



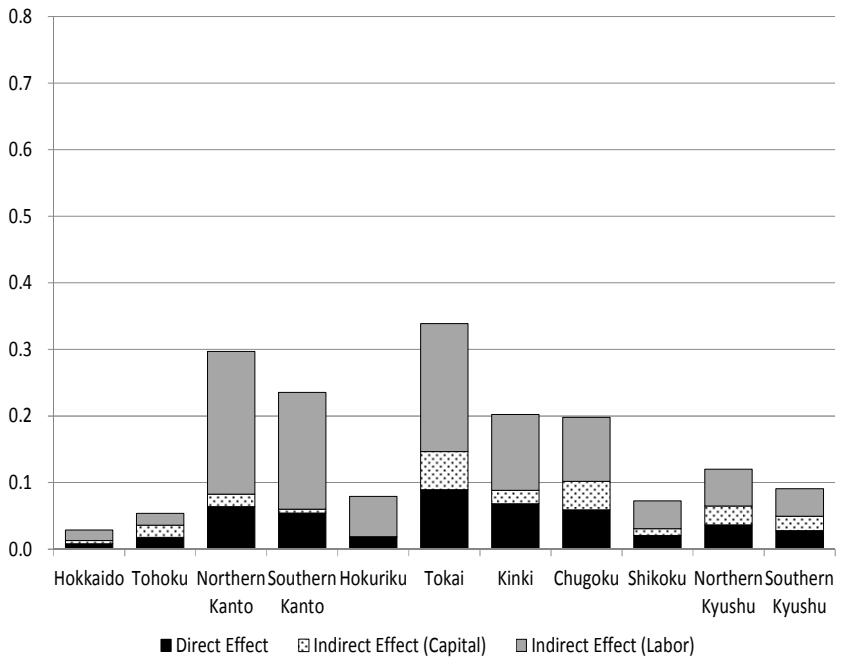
Regional Disparities of Economic Effects

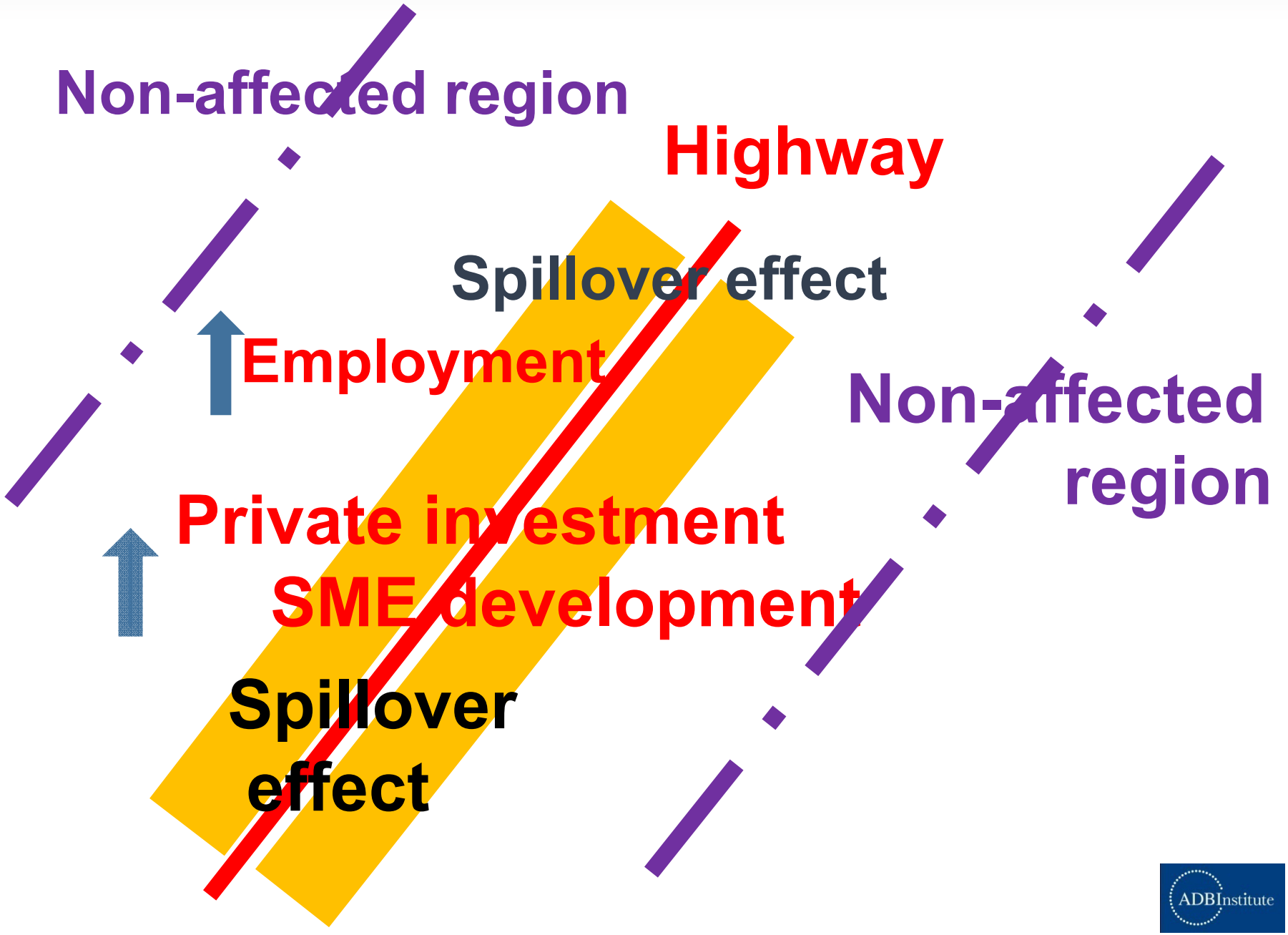
large differences in Spillover effects

1990

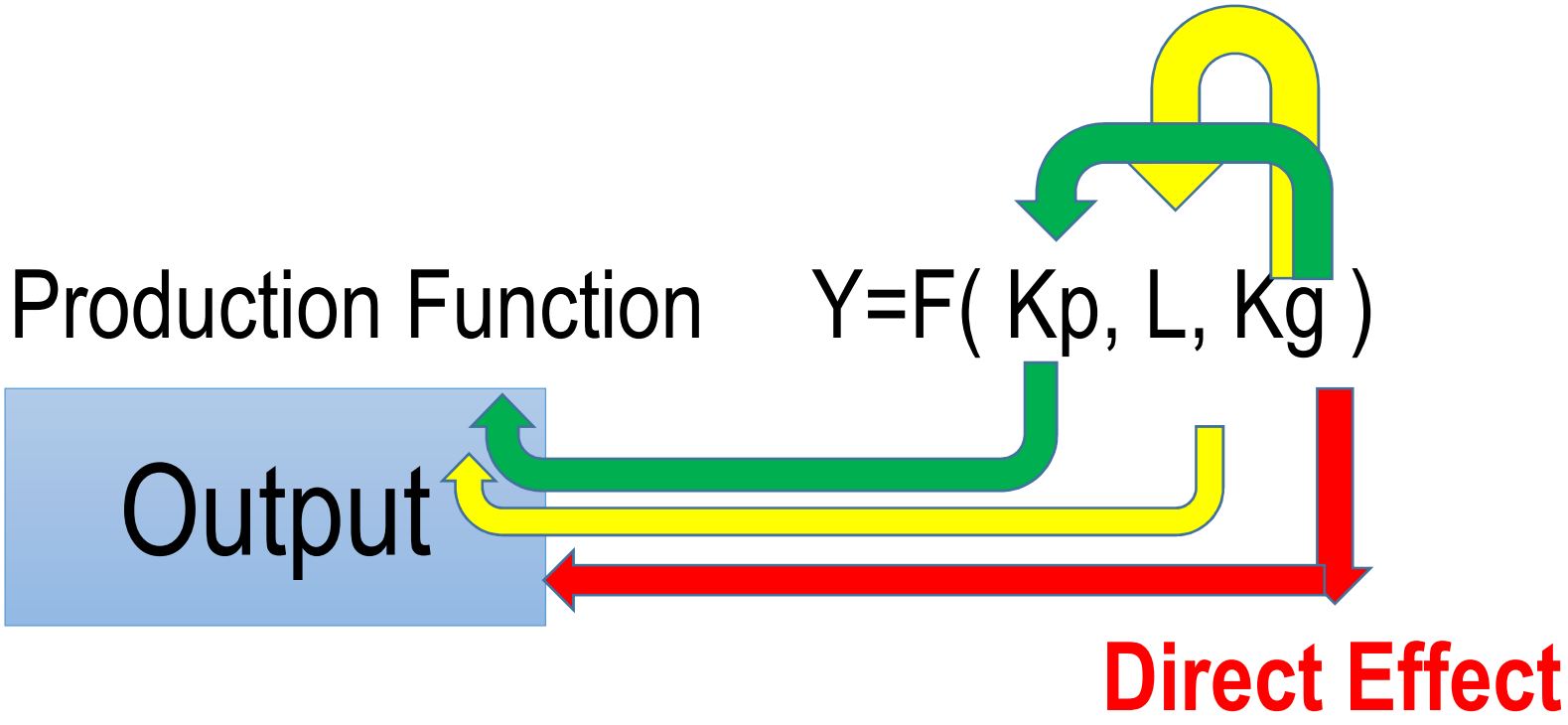


2010




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

Direct Effect and Spill-over Effects



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

Kg = public capital (infrastructure)

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

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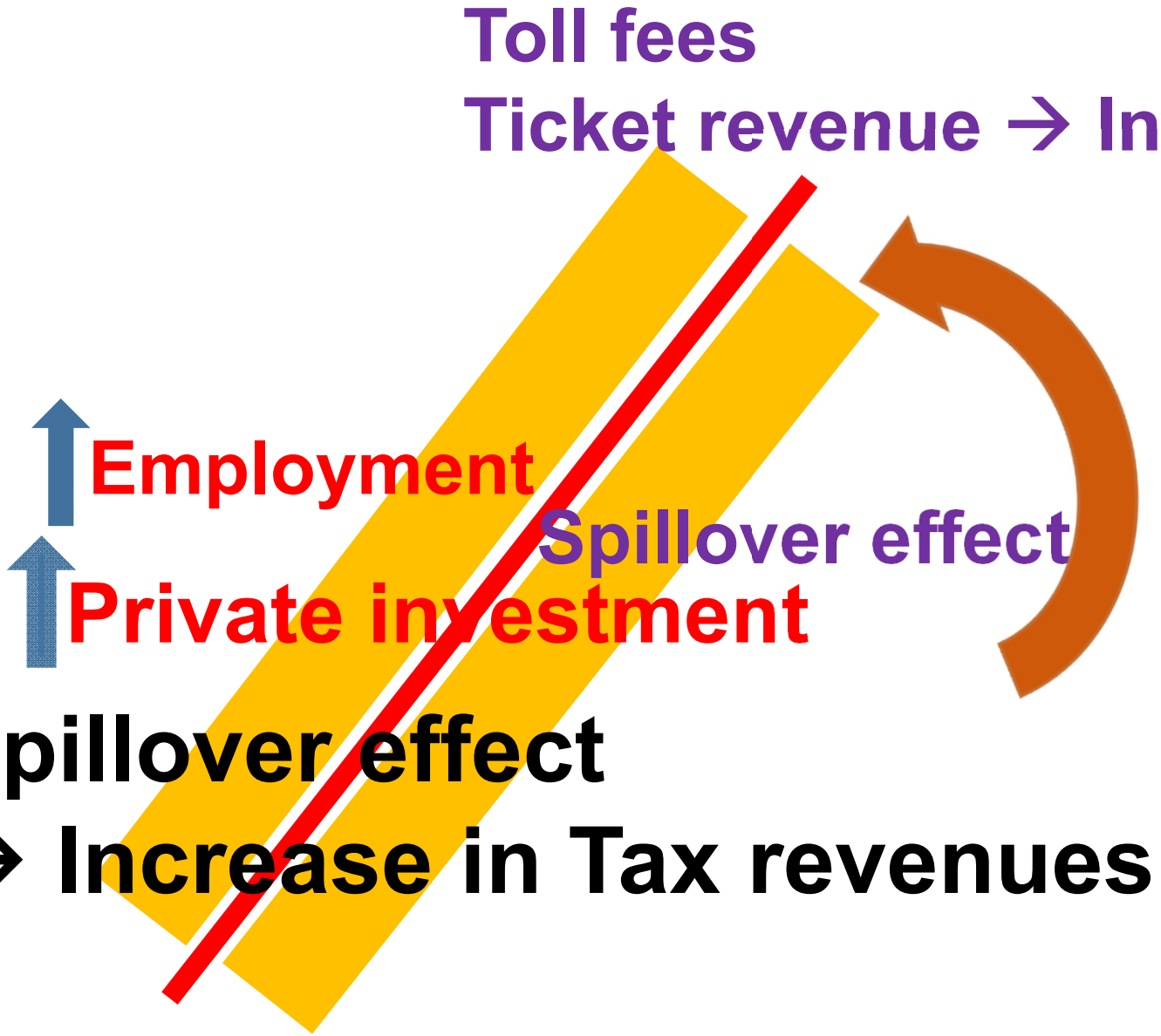
Fees + Additional return from tax revenues

→Increase rate of return on investment

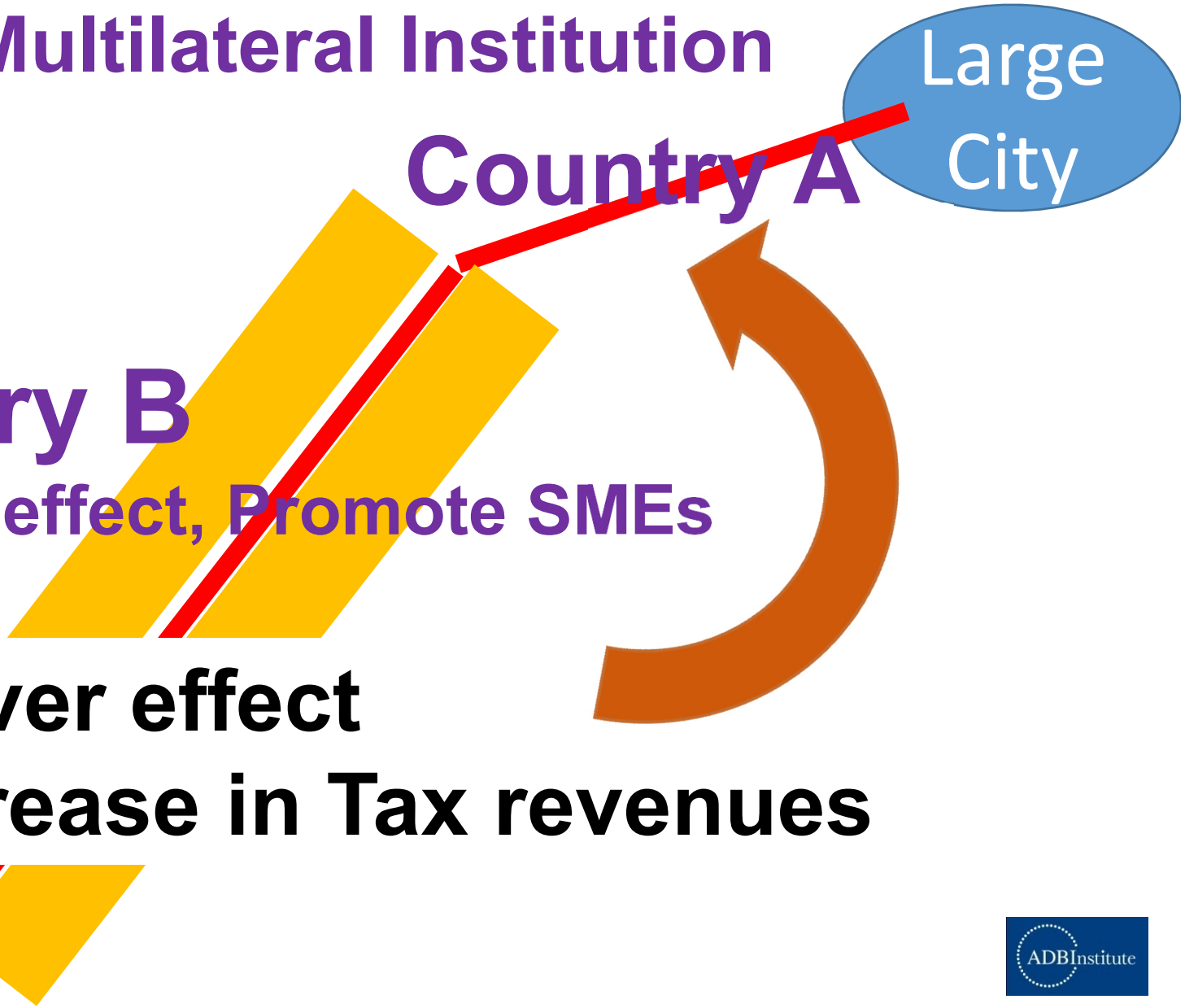


Spillover effect

→ Increase in Tax revenues

Cross-border Infrastructure Investment

Role of Multilateral Institution



Spillover effect

→ Increase in Tax revenues

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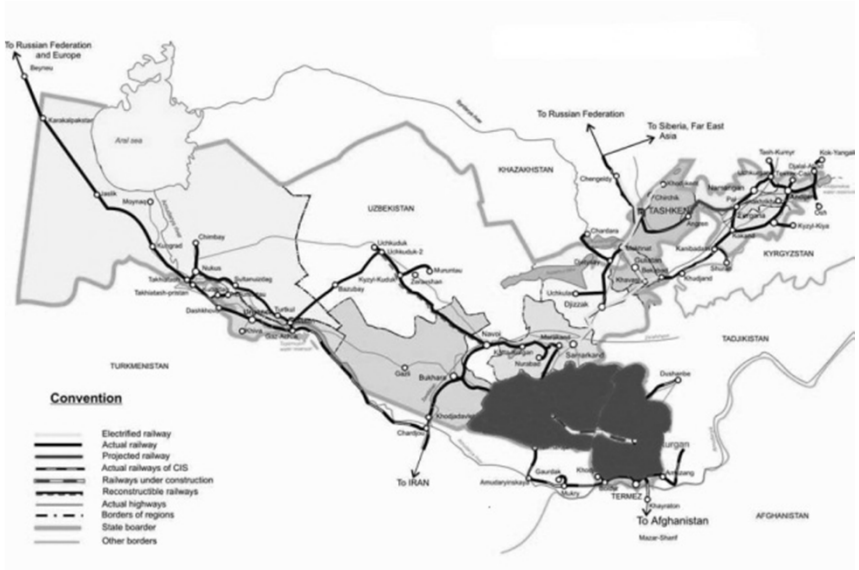
Uzbekistan Railway

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

  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 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' calculations

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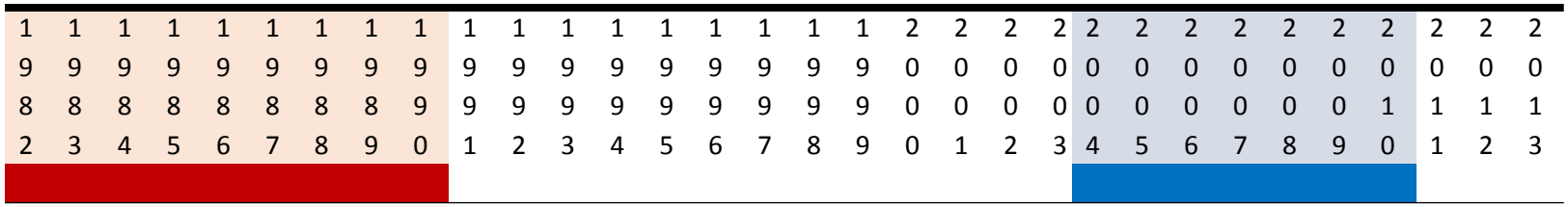
Japanese Bullet Train

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)

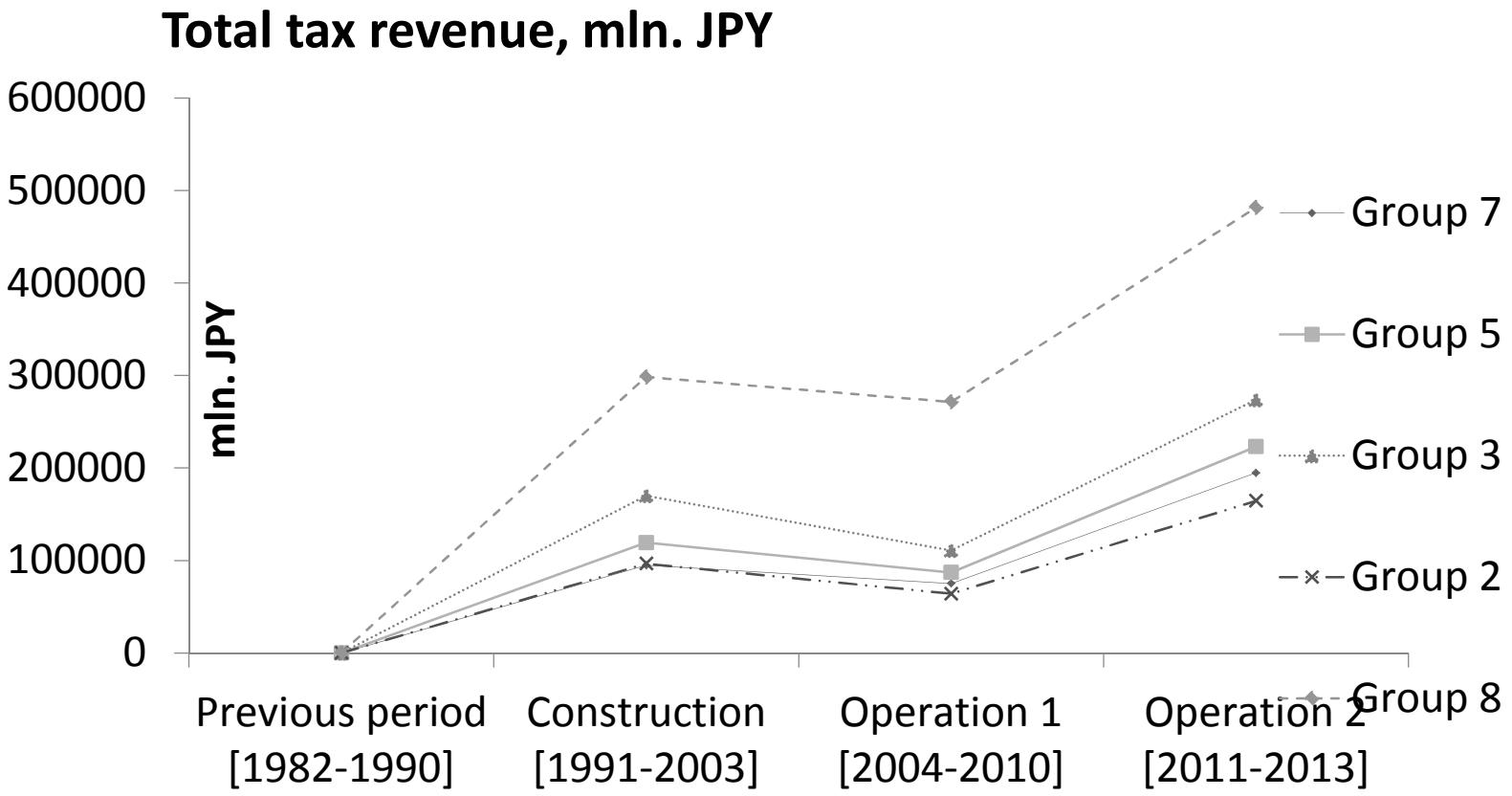
1	1	1	1	1	1	1	1	1	1	1	1	19	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
9	9	9	9	9	9	9	9	9	9	9	9	94	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0
8	8	8	8	8	8	8	8	9	9	9	9		9	9	9	9	9	0	0	0	0	0	0	0	0	0	0	1	1	1	1
2	3	4	5	6	7	8	9	0	1	2	3		5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3

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

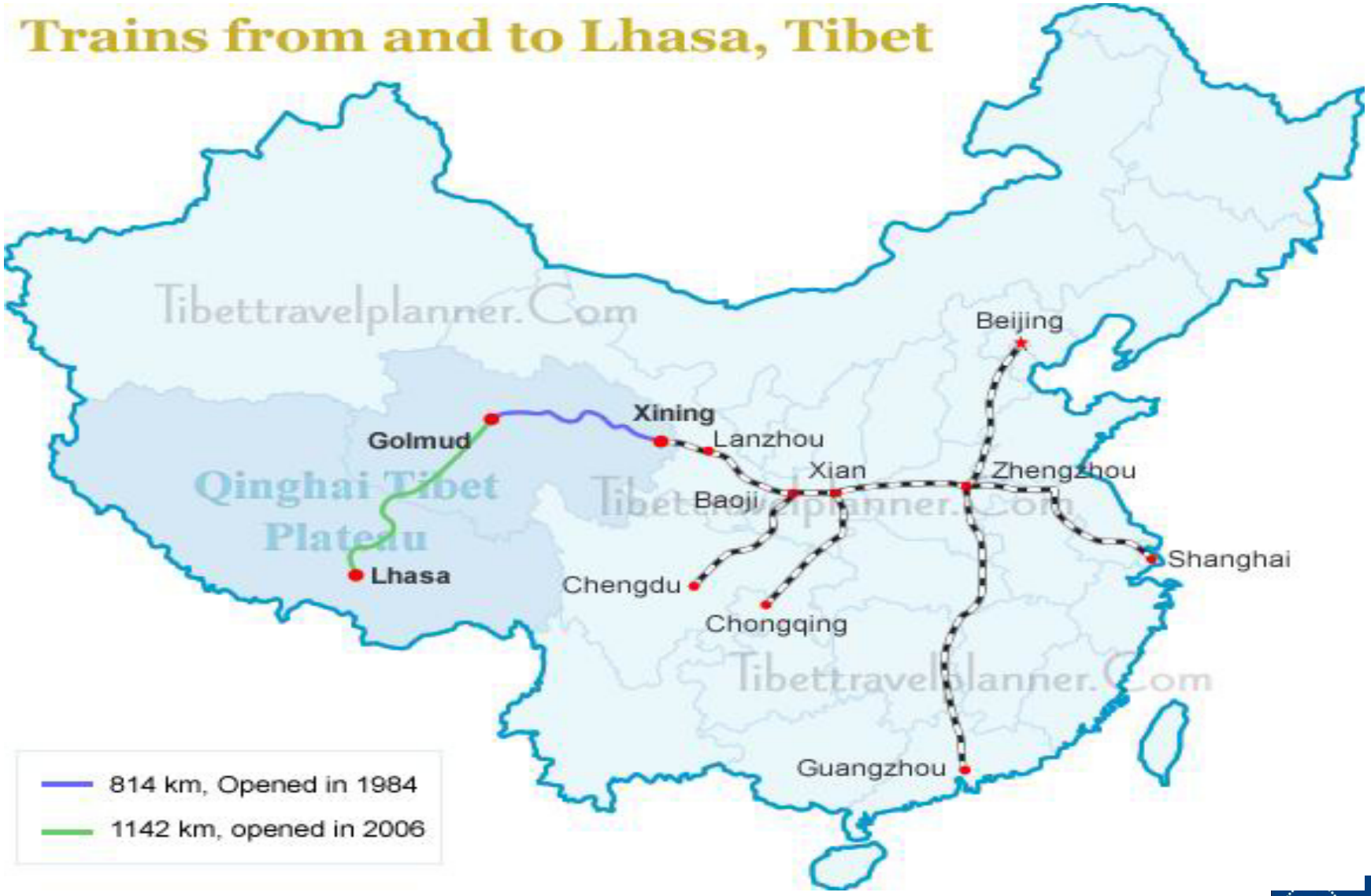
COMPOSITION OF GROUPS

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

Qinghai-Tibet Railway Map



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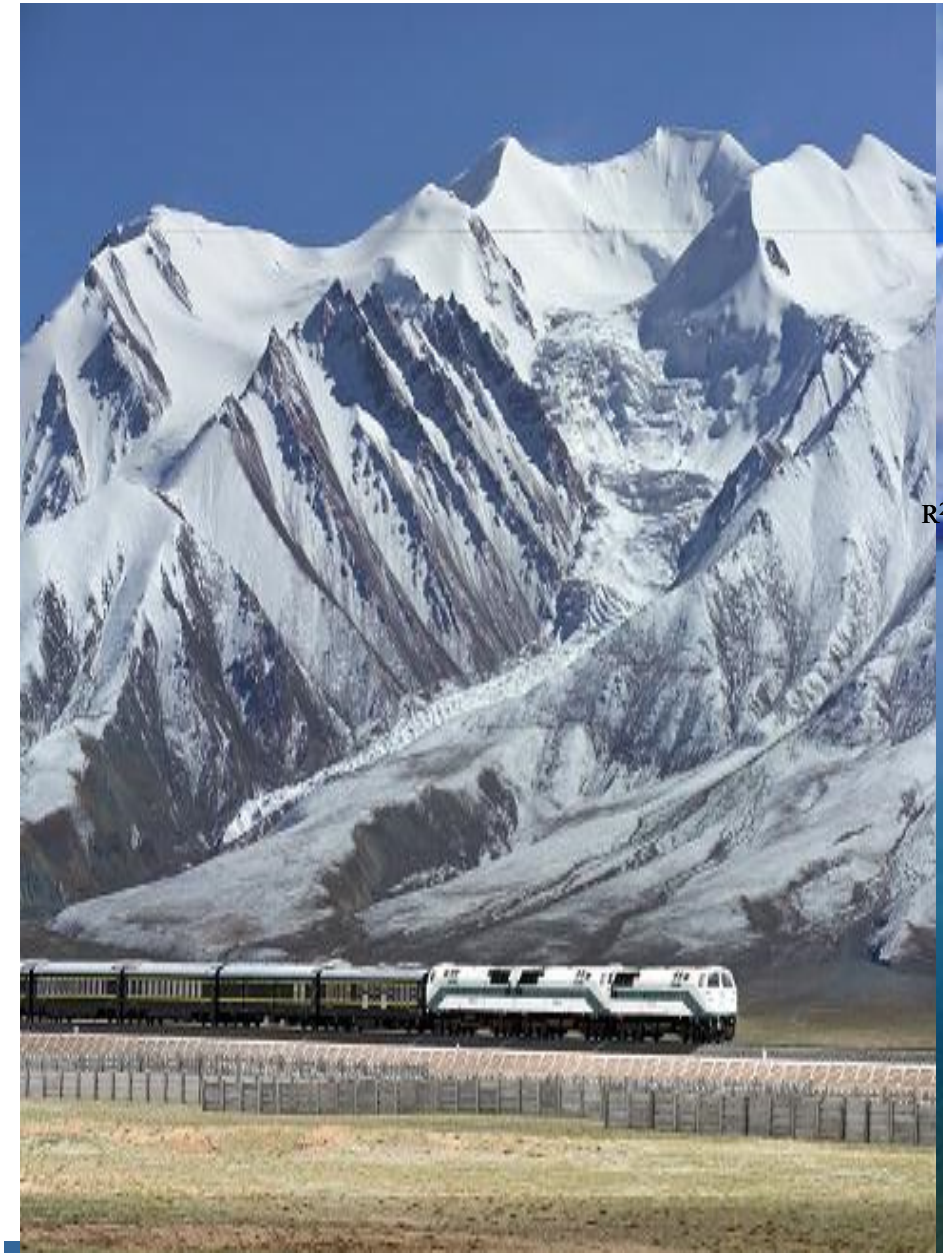
Tibet Railway



$R^2 =$

Qinghai-Tibet Railway Impact: Estimation

Source	SS	df	MS
Model	8.28173613	6	1.38028935
Residual	11.6075298	65	.178577382
Total	19.8892659	71	.280130506

Number of obs	= 72
F(6, 65)	= 7.73
Prob > F	= 0.0000
R-squared	= 0.4164
Adj R-squared	= 0.3625
Root MSE	= .42258

difference1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
govspending1	.0118414	.0028554	4.15	0.000	.0061389	.017544
population1	.0034233	.0013616	2.51	0.014	.000704	.0061426
population0	-.0102002	.0037957	-2.69	0.009	-.0177808	-.0026196
govspending0	-.0206841	.0055783	-3.71	0.000	-.0318248	-.0095435
Dummy	.0924005	.2097625	0.44	0.661	-.3265242	.5113252
Dummy2	.061252	.1937049	0.32	0.753	-.3256034	.4481074
_cons	.4984291	.2045091	2.44	0.018	.0899961	.906862

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.

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