"Impact evaluation of infrastructure provision: case studies from Uzbekistan"

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Research framework

concept: infrastructure* provision

objective: examine the nature and magnitude of economics returns from infrastructure provision on financial performance of enterprises and institutions

context: Uzbekistan, 2005:2012

methodology: difference-in-difference approach

point of novelty: empirical strategy allows mapping out differential impact of infrastructure provision across

- geographical locations
- time frames
- economic segments; types of tax revenue

***Note:** Infrastructure (n): The basic physical and organizational structures and facilities (e.g. buildings, roads, railways, power supplies) needed for the operation of a society or enterprise

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- Tax increment financing (TIF)

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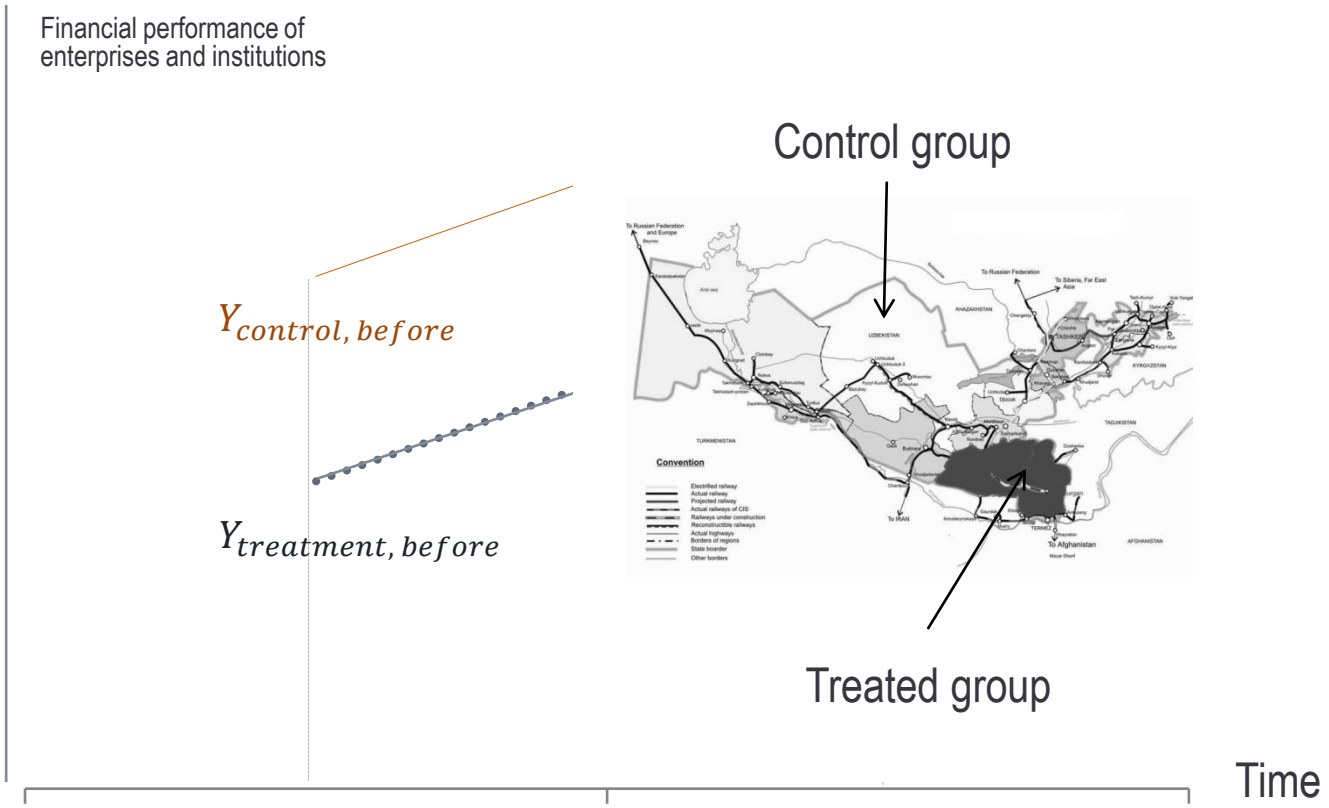
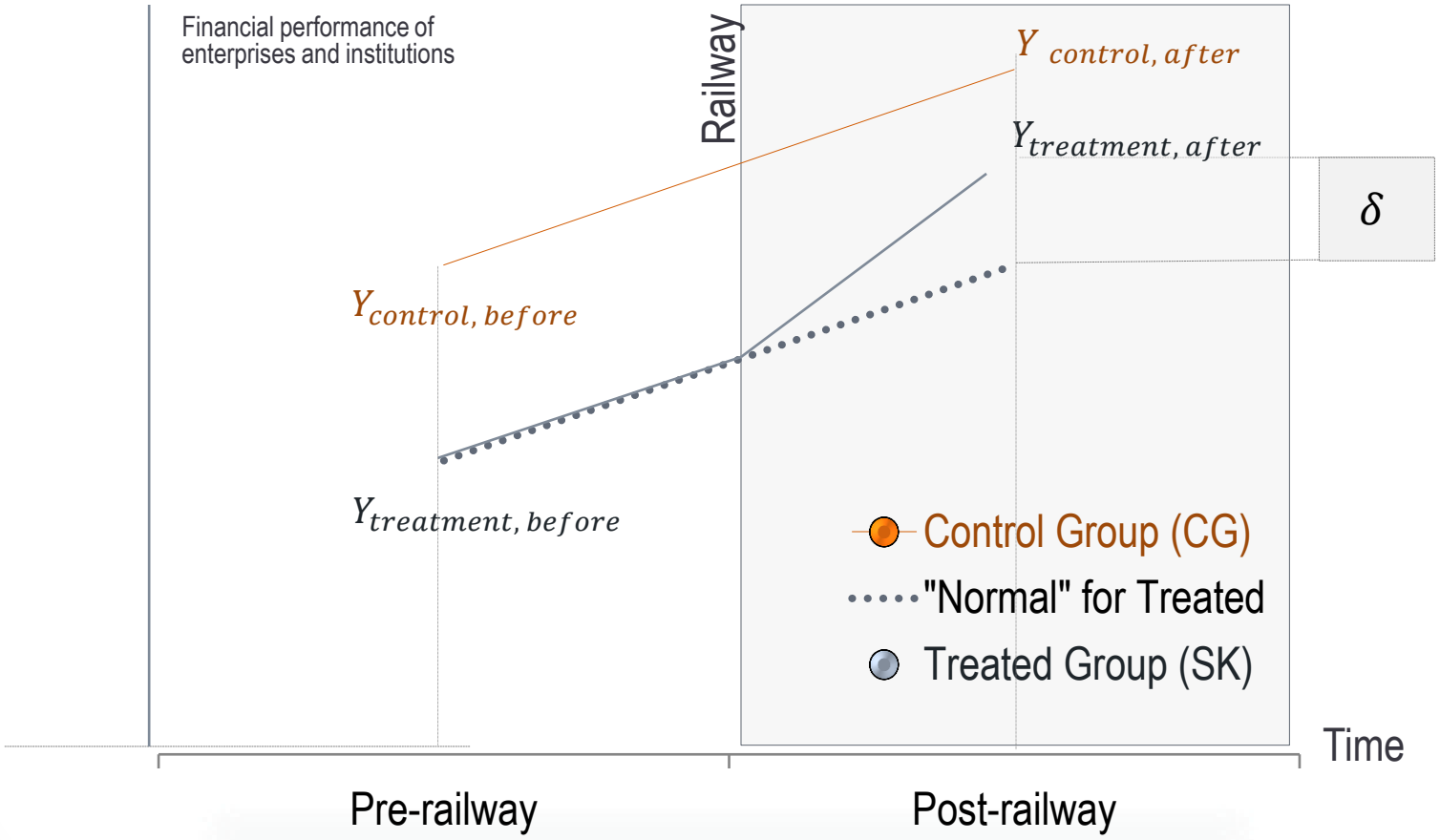
Methodology: difference-in-difference



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

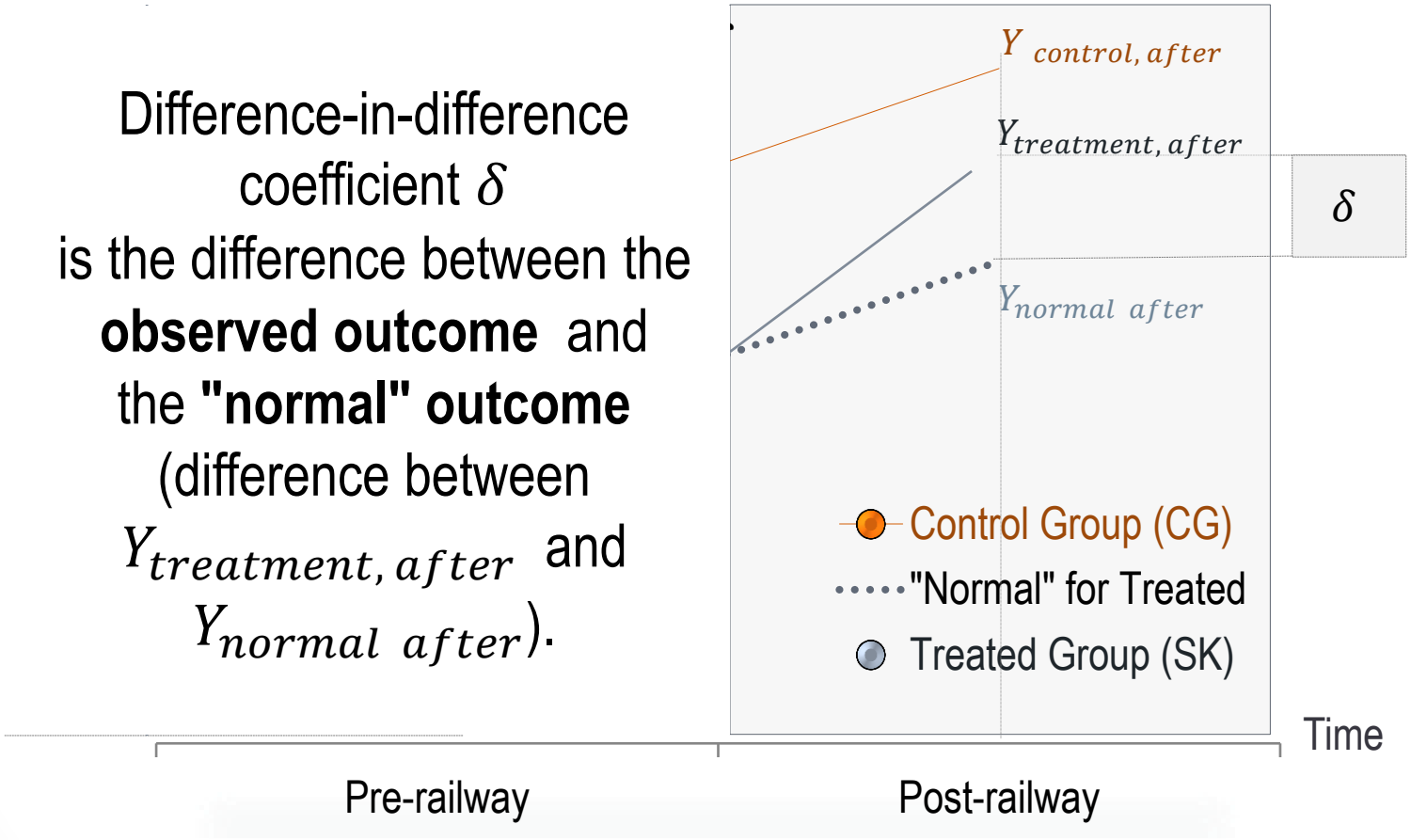
Methodology: difference-in-difference



Measure “outcomes” for both groups before and after introduction of railway

Methodology: difference-in-difference

Difference-in-difference coefficient δ is the difference between the **observed outcome** and the **"normal" outcome** (difference between $Y_{treatment,\,after}$ and $Y_{normal\ \ after}$).



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Determinants of financial performance of enterprises and institutions

- Financial performance is determined by:
  - time-invariant region specific effects(γ_i) :
    - idiosyncratic features of a region proceeding from historical, cultural and social development
  - year specific effects (φ_t)
    - changes in legislation, overall business climate
  - time varying covariates(X_{it})
    - External trade, labor force etc.

Difference-in-difference: regression

- incorporating time varying covariates

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

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

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

  F_{it} - Financial performance of institutions and enterprises

  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

Difference-in-difference: regression

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

  X_{it}-time varying covariates

  - External trade turnover (USD mln.)
  - Total investment (bln.soms)
  - Labor force
  - Number of small enterprises and microfirms (total)

Difference-in-difference: regression

- $F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + \delta\left(D_{rail} \times D_{post}\right) + \epsilon_{it}$
- Fixed effects estimation
  - Demeaning(within estimator)

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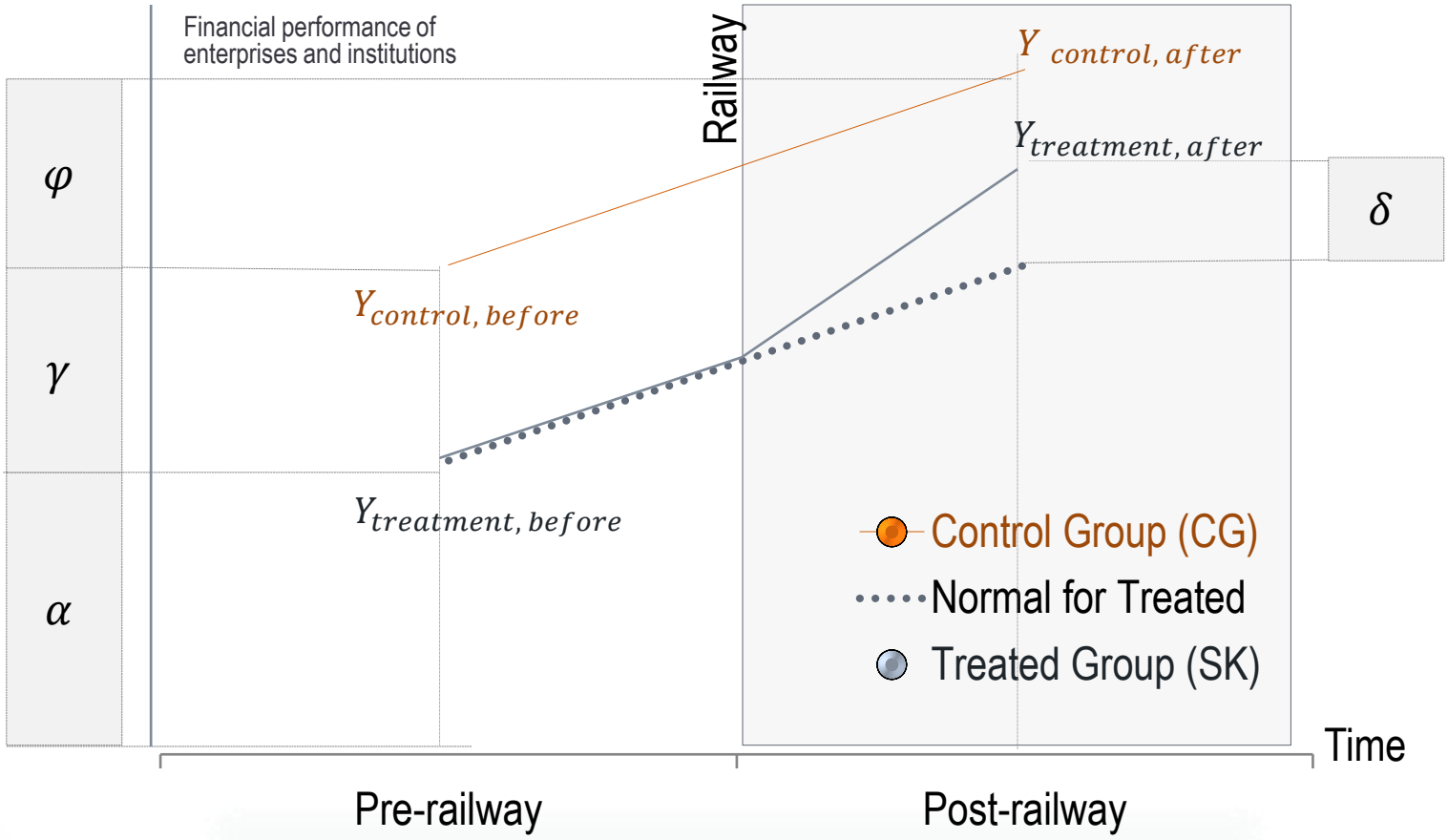
Assumption: common trend



$$F_{it} = \alpha + \gamma_i + \varphi_t + X'_{it}\beta + \delta\left(D_{rail} \times D_{post}\right)_{it} + \epsilon_{it}$$

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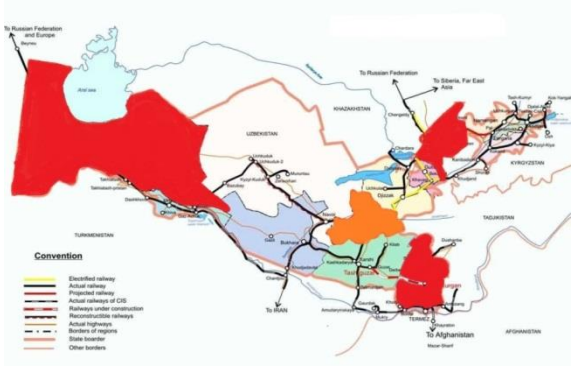
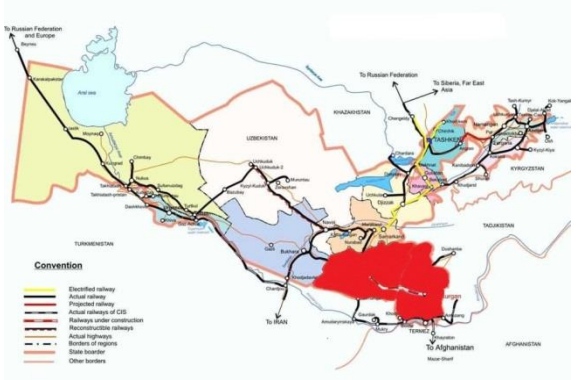
Scale of focus: case of TBK railway

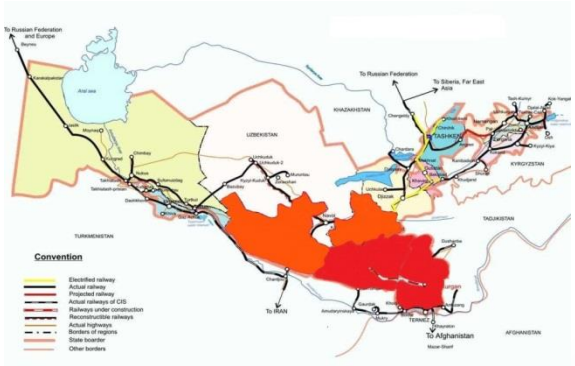
- Connectivity effect



- Regional effect



- Spillover effects



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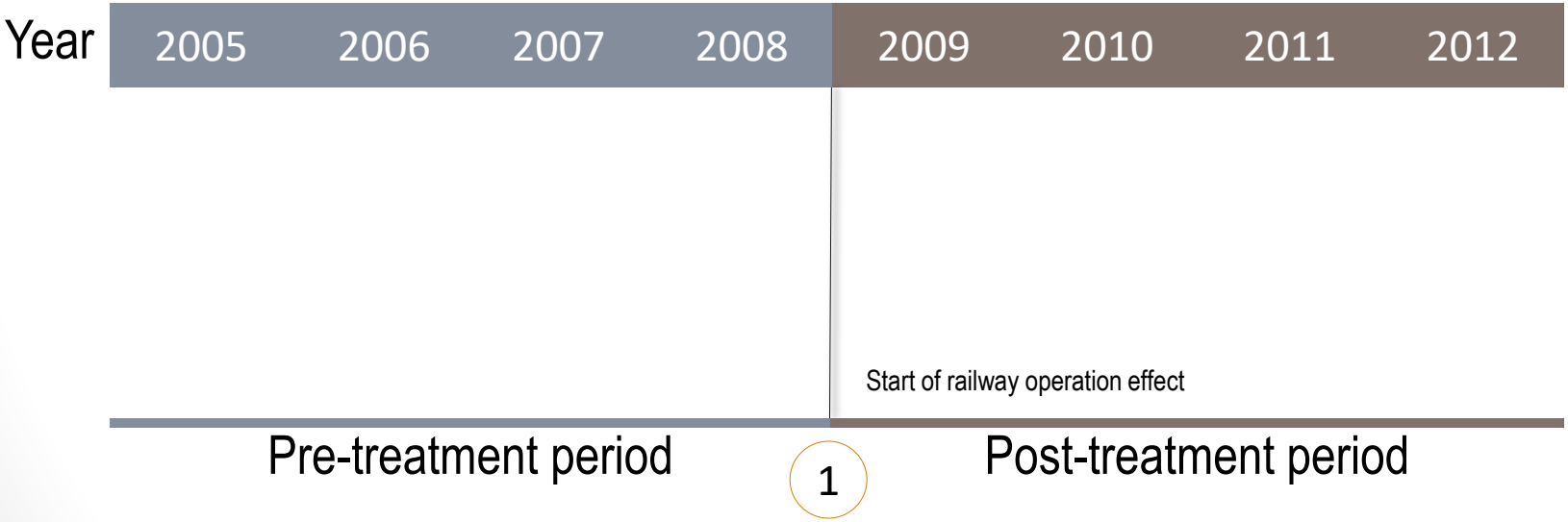
Timing

Year	2005	2006	2007	2008	2009	2010	2011	2012

Launching effects

$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{t>2008}) + \epsilon_{it}$$

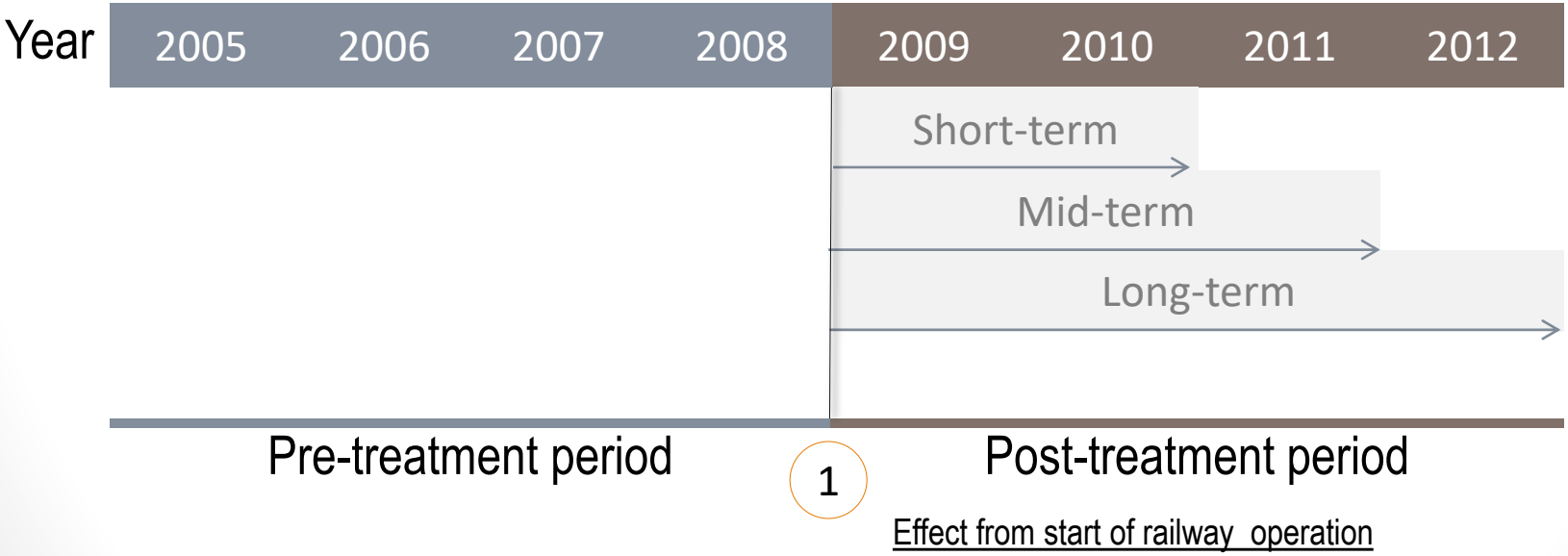


Launching effects

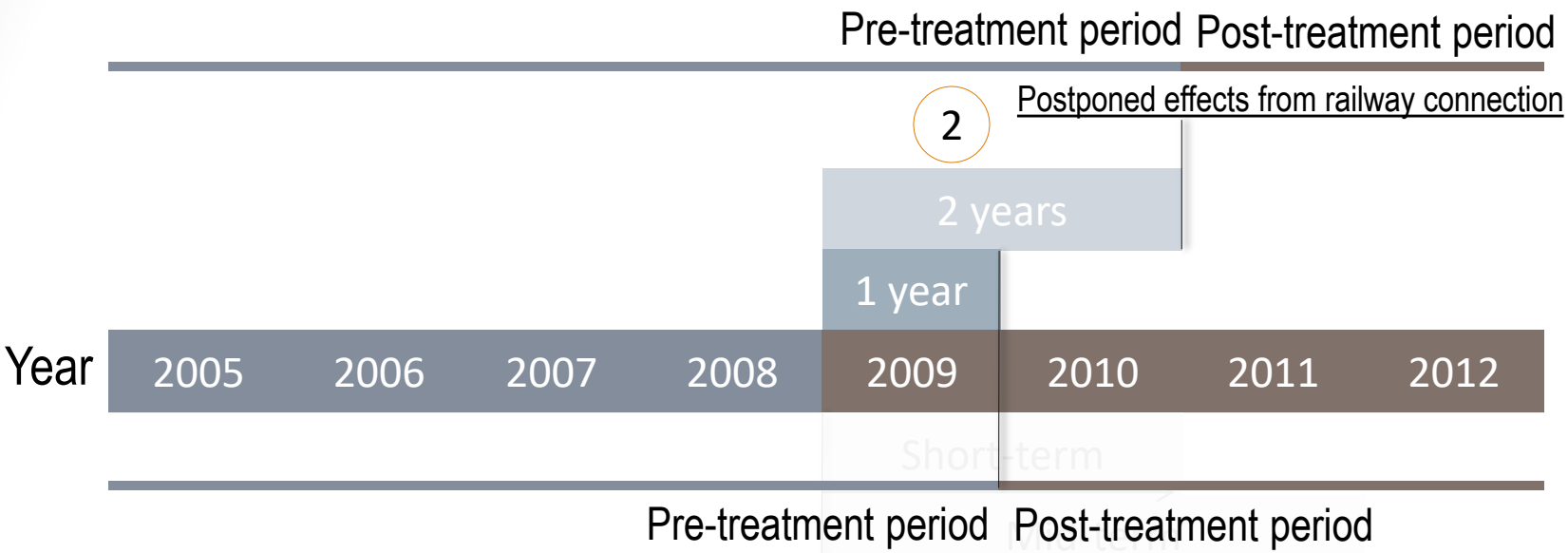
$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{2010>t>2008}) + \epsilon_{it}$$

$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{2011>t>2008}) + \epsilon_{it}$$

$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{2012>t>2008}) + \epsilon_{it}$$



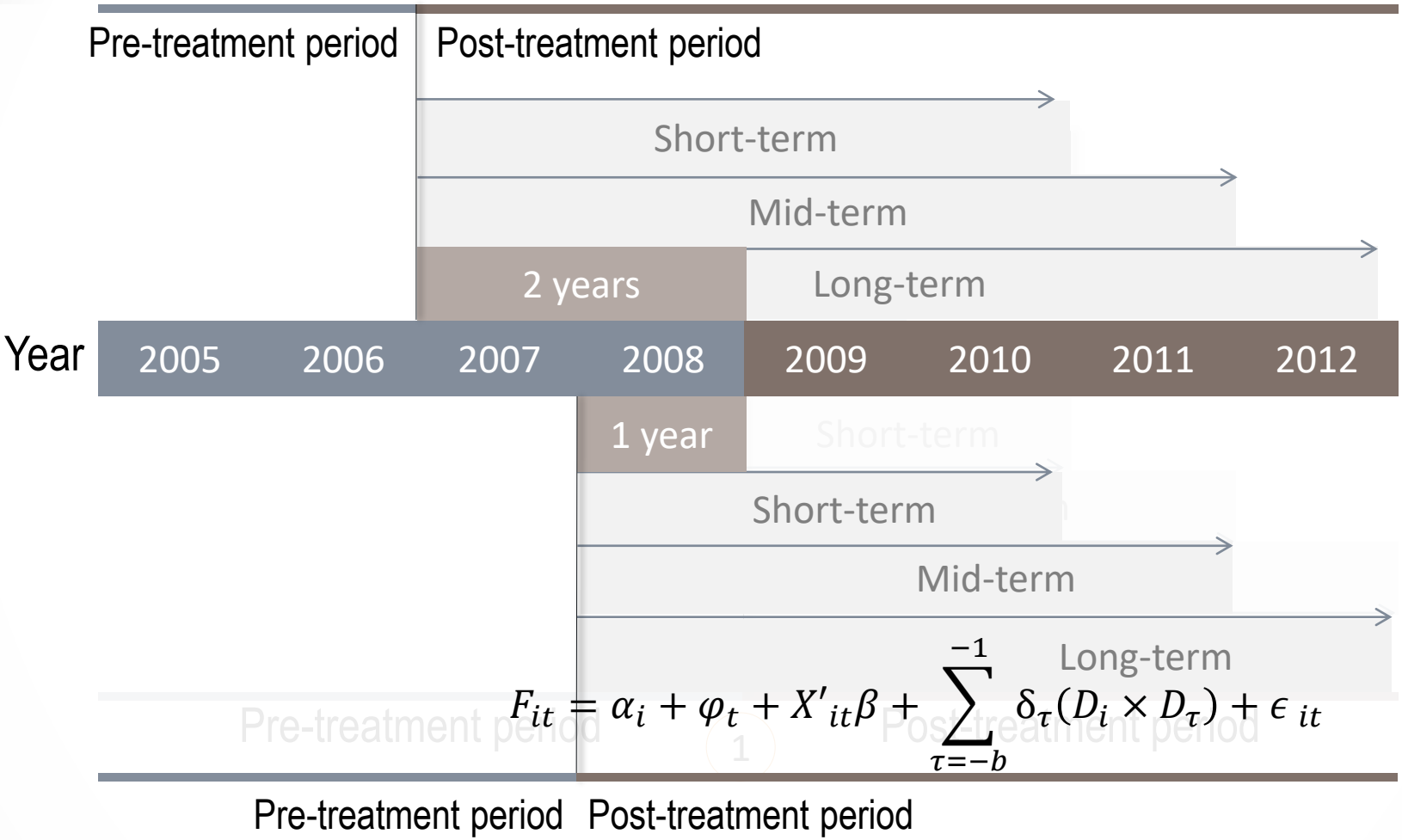
Postponed effects



$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{2012>t>2010}) + \epsilon_{it}$$

$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + (D_i \times D_{2012>t>2009}) + \epsilon_{it}$$

Anticipation effects



$$F_{it} = \alpha_i + \varphi_t + X'_{it}\beta + \sum_{\tau=-b}^{-1} \delta_\tau (D_i \times D_\tau) + \epsilon_{it}$$

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Anticipation effects of railway connection

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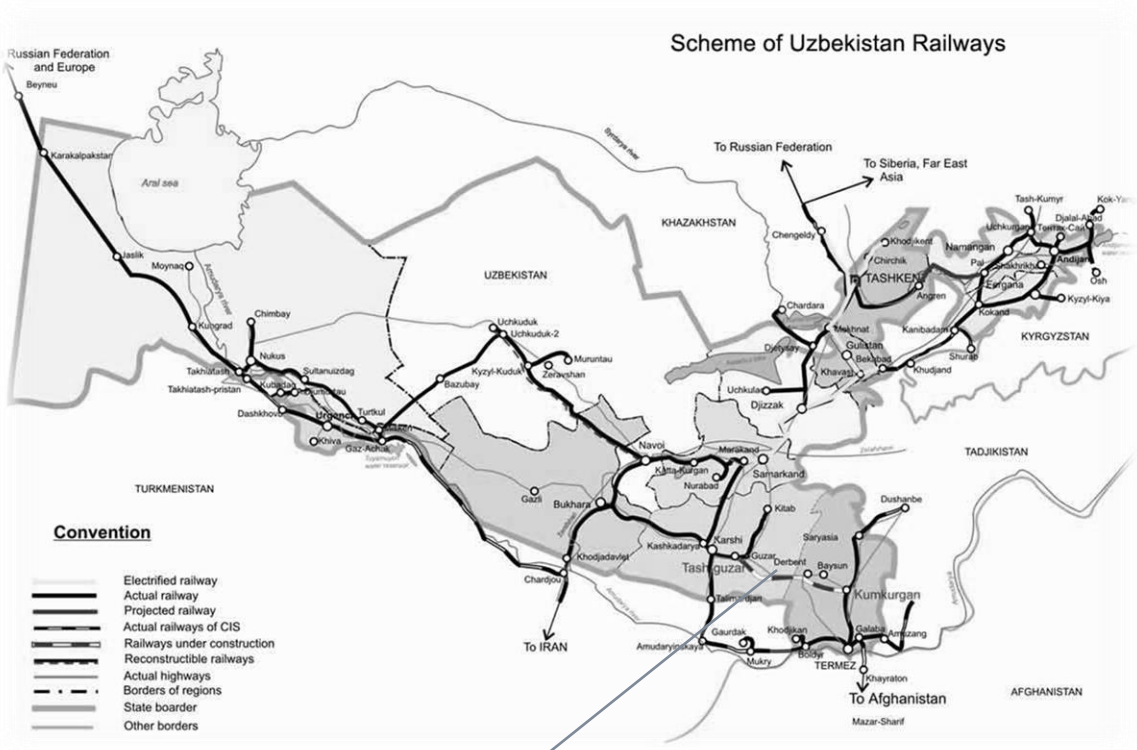
Context: Uzbekistan



Tashguzar – Baysun – Kumkurgan (TBK) Railway Line
Uzbekistan

Estimation output for long-term regional effects

Time period	2005-2012 **Regression 1**	2005-2012 **Regression 2**	2005-2012 **Regression 3**	2005-2012 **Regression 4**
State effects	Yes	Yes	Yes	Yes
Time effect	No	Yes	Yes	Yes
Difference-in-difference	199.016 (2.16)**	252.475 (2.63)**	261.268 (2.77)**	318.811 (3.53)**
Total investment	0.140 (4.15)***	0.178 (4.50)**	0.182 (4.66)**	0.122 (3.04)**
External trade turnover	0.232 (18.86)***	0.225 (17.50)**	0.231 (17.88)**	0.231 (18.93)**
Labor force	-	-	-0.093 (2.24)*	-0.191 (4.05)**
№ of small enterprises	-	-	-	0.008 (3.74)**
Constant	-99.697 (4.02)***	-78.462 (2.89)**	12.805 (0.26)	-58.193 (1.17)
R^2	0.90	0.90	0.91	0.92
N	112	112	112	112

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

Estimation output for mid-term regional effects

Time period	2005-2012 **Regression 1**	2005-2012 **Regression 2**	2005-2012 **Regression 3**	2005-2012 **Regression 4**
State effects	Yes	Yes	Yes	Yes
Time effect	No	Yes	Yes	Yes
Difference-in-difference	146.739 (1.56)	187.863 (1.91)	**195.087** (2.02)*	**245.747** (2.64)**
Total Investment	0.127 (3.75)***	0.155 (3.88)**	0.157 (4.99)**	0.105 (2.61)*
External trade turnover	0.240 (19.09)***	0.235 (17.95)**	0.242 (18.22)**	0.242 (19.24)**
Labor force	-	-	-0.092 (2.12)*	-0.185 (3.73)**
№ of small enterprises	-	-	-	0.007 (3.36)**
Constant	-92.766 (3.81)***	-79.837 (3.05)**	9.819 (0.20)	-48.141 (0.96)
R^2	0.91	0.91	0.91	0.92
N	98	98	98	98

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

Estimation output for 1-year regional postponed effects

Time period	2005-2012 **Regression 1**	2005-2012 **Regression 2**	2005-2012 **Regression 3**	2005-2012 **Regression 4**
State effects	Yes	Yes	Yes	Yes
Time effect	No	Yes	Yes	Yes
Difference-in-difference	356.403 (3.95)***	446.319 (4.81)**	459.331 (5.07)**	491.275 (5.68)**
Total Investment	0.132 (4.14)***	0.185 (5.15)**	0.188 (5.36)**	0.164 (4.83)**
External trade turnover	0.236 (20.03)***	0.225 (18.95)**	0.232 (19.49)**	0.229 (20.10)**
Labor force	-	-	-0.098 (2.54)*	-0.168 (4.04)**
№ of small enterprises	-	-	-	0.006 (3.54)**
Constant	-98.075 (4.16)***	-78.308 (3.29)**	18.174 (0.41)	-21.429 (0.49)
R^2	0.91	0.92	0.92	0.93
N	112	112	112	112

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

Estimation output for all cases

			Regional effect	Spillover effect	Connectivity effect
		D_t D_i	$D_g = regional$	$D_g = spillover$	$D_g = connectivity$
Launch effects					
	Short-term	$D_{t=(2010:2009)}$	22.886 (0.29)	-101.619 (1.60)	-33.880 (0.56)
	Mid-term	$D_{t=(2011:2009)}$	**245.747** (2.64)**	31.597 (0.40)	-29.421 (0.40)
	Long-term	$D_{t=(2012:2009)}$	**318.811** (3.53)**	81.156 (1.03)	-11.967 (0.16)
Anticipation effects					
1 year	Short-term	$D_{t=(2010:2008)}$	-29.616 (0.40)	-82.686 (1.42)	-3.214 (0.06)
	Mid-term	$D_{t=(2011:2008)}$	137.818 (1.44)	-11.762 (0.15)	-6.277 (0.08)
	Long-term	$D_{t=(2012:2008)}$	206.355 (2.14)*	19.849 (0.25)	2.723 (0.04)
Postponed effects		$D_{t=(2012:2010)}$	**491.275** (5.68)***	156.736 (2.02)*	5.601 (0.07)
Anticipation effects					
2 years	Short-term	$D_{t=(2010:2007)}$	-33.313 (0.42)	-65.749 (1.08)	-33.678 (0.56)
	Mid-term	$D_{t=(2011:2007)}$	95.749 (0.91)	-21.316 (0.25)	-35.996 (0.44)
	Long-term	$D_{t=(2012:2007)}$	155.936 (1.43)	-0.905 (0.01)	-29.011 (0.34)
Postponed effects		$D_{t=(2012:2011)}$	**559.690** (5.86)***	197.991 (2.32)*	12.941 (0.15)

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

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Policy implications

- Evidence-based infrastructure financing
- Central or local infrastructure financing
- Mechanisms of local financing (Hometown trust funds)
- Tax Increment Financing (TIF)