Dispersion of Agglomeration through Transport Infrastructure

A Case of China's High-speed Rail

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High-speed rail: are the billion RMB investments worthwhile?

Political cartoon removed due to copyright restrictions.
Source: Image included in Bai, Gao. "Debate: High-speed trains," China Daily, June 20, 2011.

Motivation of research

- **Pending policy inquiries**
  - Will high-speed rail bring growth opportunities?
  - For project appraisal, what is missing from the standard cost-benefit analysis?
  - How to quantify the claimed wider economic benefits (externalities), if they do exist?
  - A win-win situation or a zero-sum game?

Question & Hypothesis

- How do major transport infrastructure investment influence urban economic performance?
- By facilitating cities' access to external resources, which are partial substitutes for their own endowment.

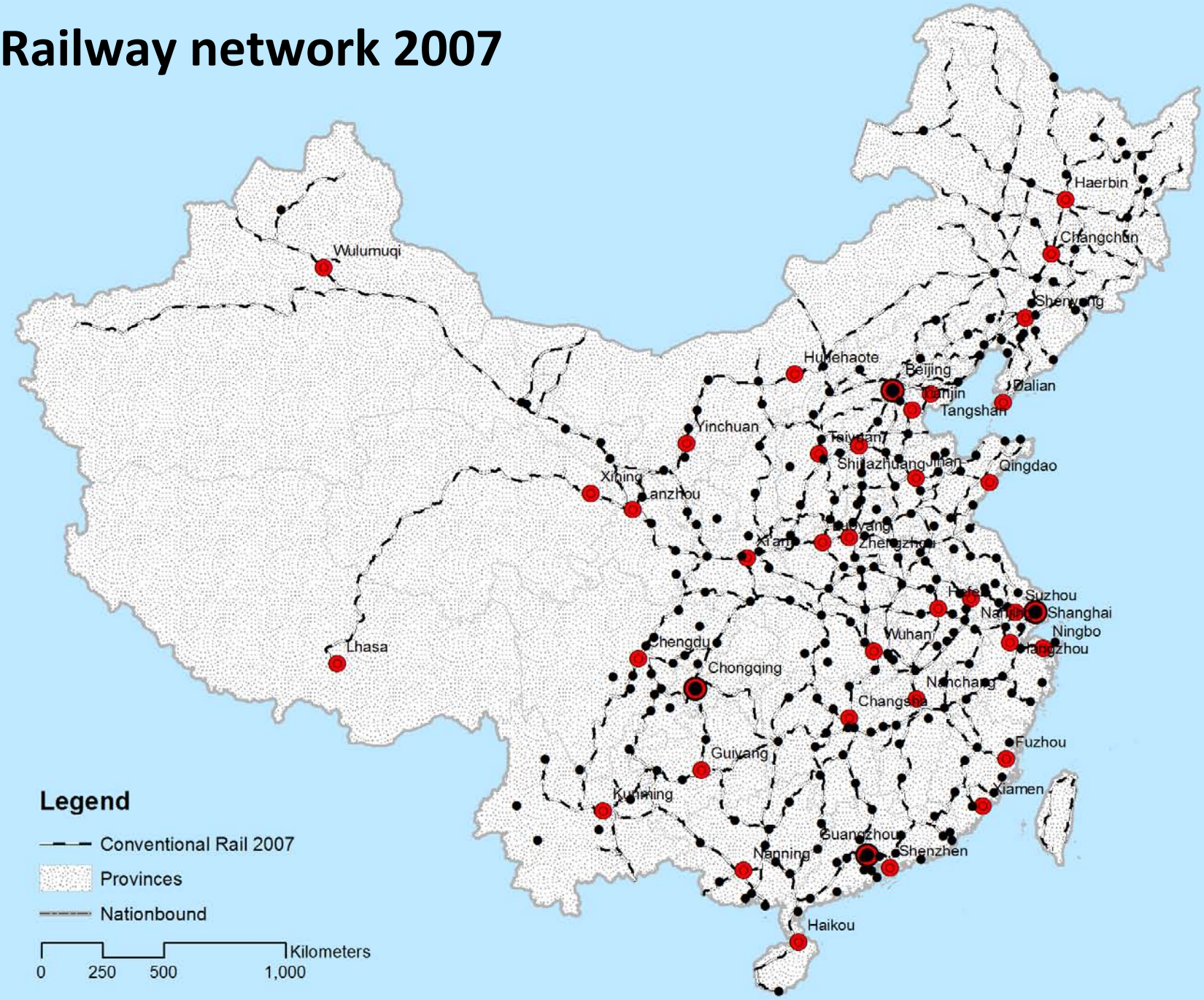
Redefine agglomeration

- **Economies** of **agglomeration** describes the benefits that firms derive by locating near each other.
- **Internal vs. external scale of production**

Accessibility patterns

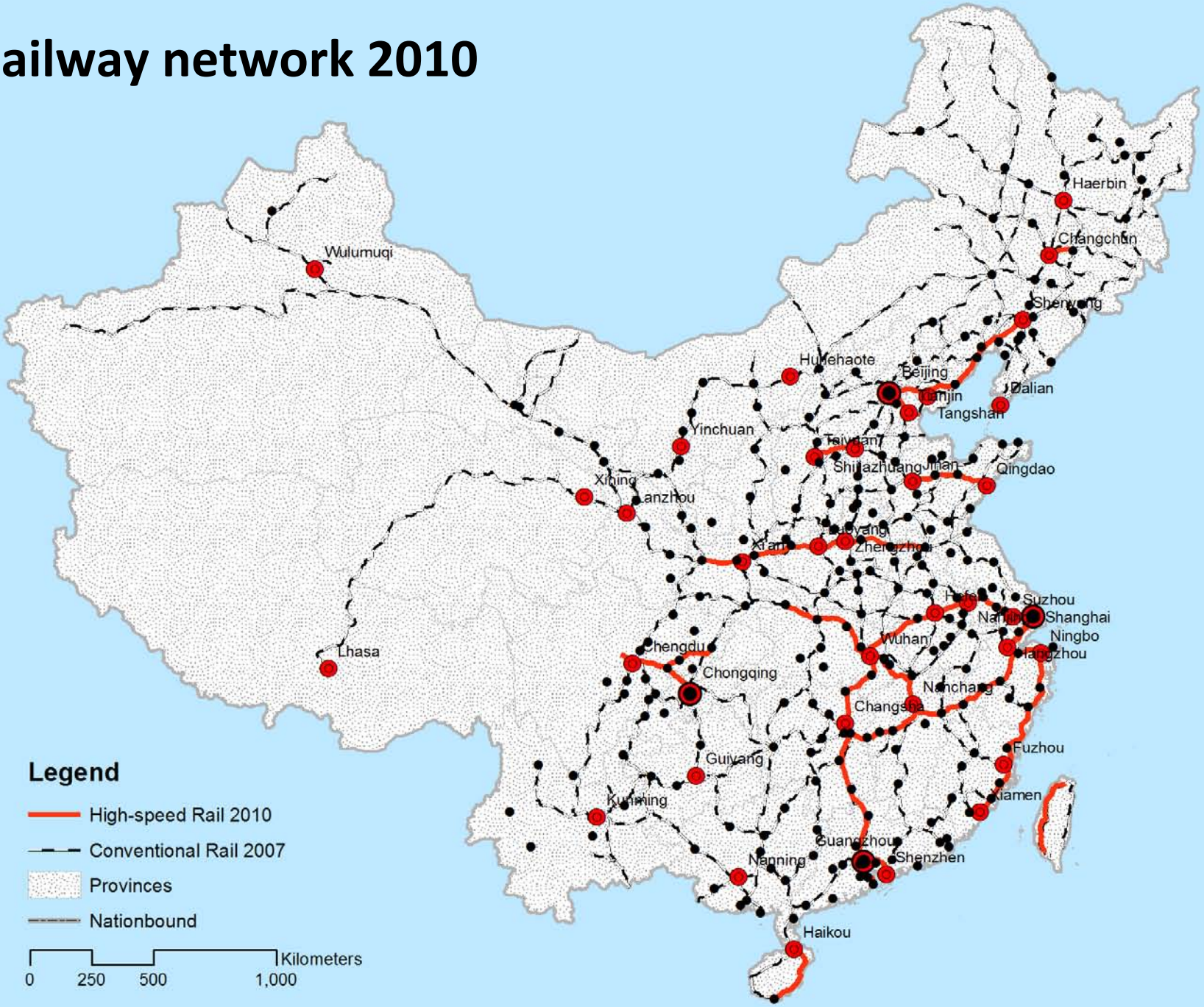
- **Key inquiries**
  - Evolution of accessibility patterns during 2001-2010
  - The role of HSRs in shaping accessibility
- **Method**
  - Spatial analysis using GIS tools

Railway network 2007



National HSR plan 2008
Four vertical, four horizontal PDLs

Railway network 2010

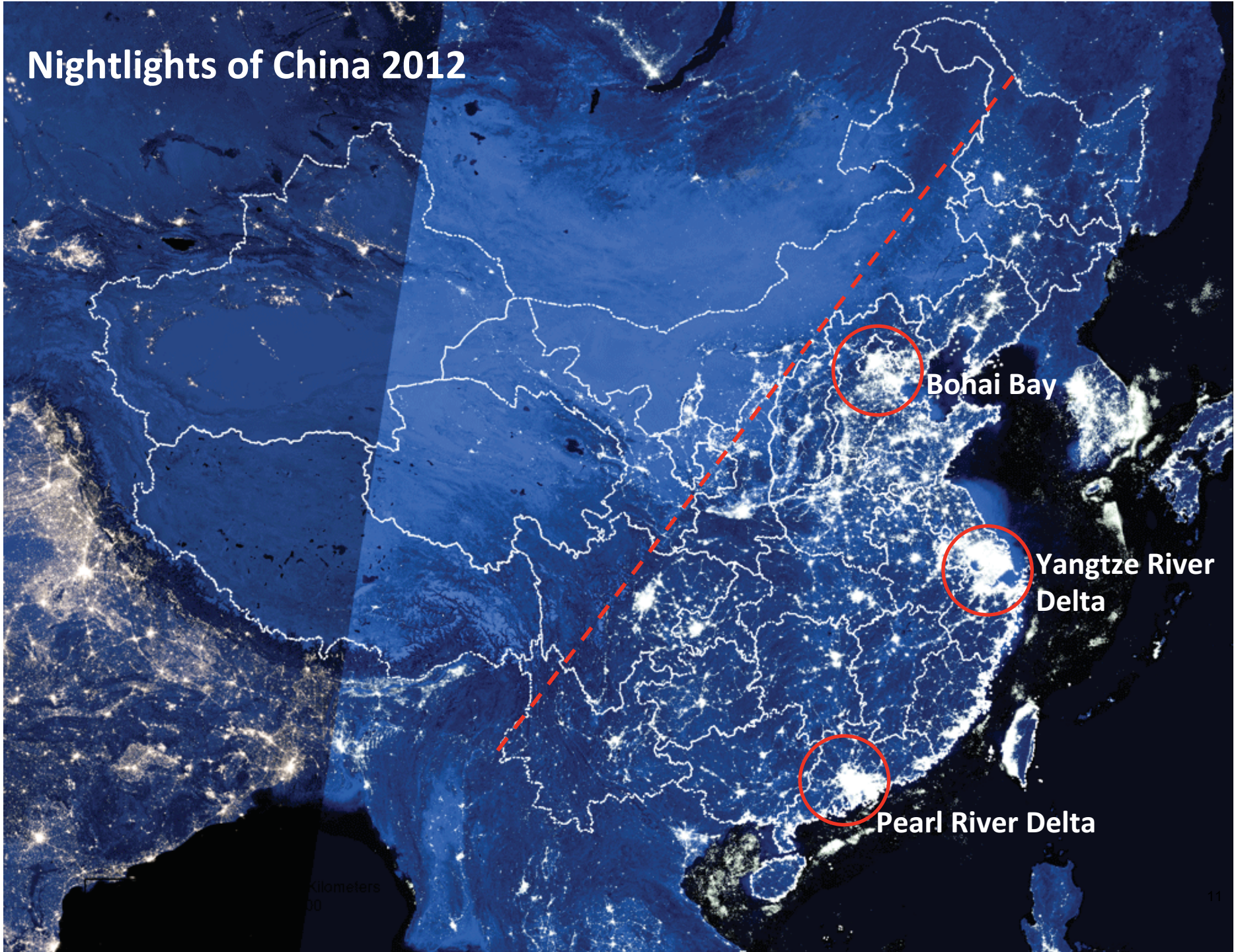


Facts about China's HSR

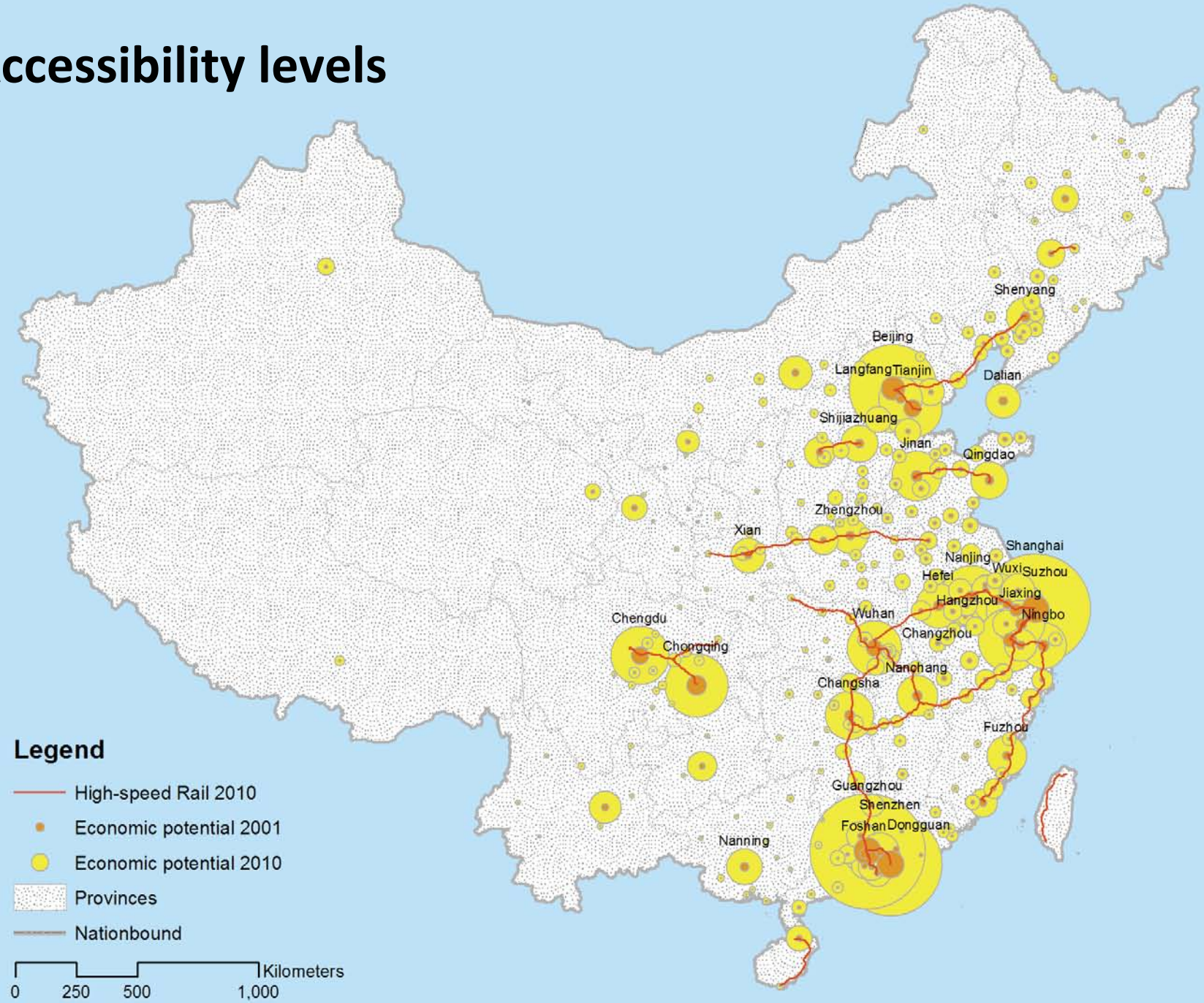
- ***Definition:*** High-speed rail (HSR) in China refers to any commercial train service with average speed of **200 km/h** (124 mph) or higher.

- ***Length:*** China has the world's longest HSR network with about **9,300** km (5,800 mi) of routes in service as of December 2012, including the world's longest line, the 2,298 km (1,428 mi) Beijing-Guangzhou HSR.

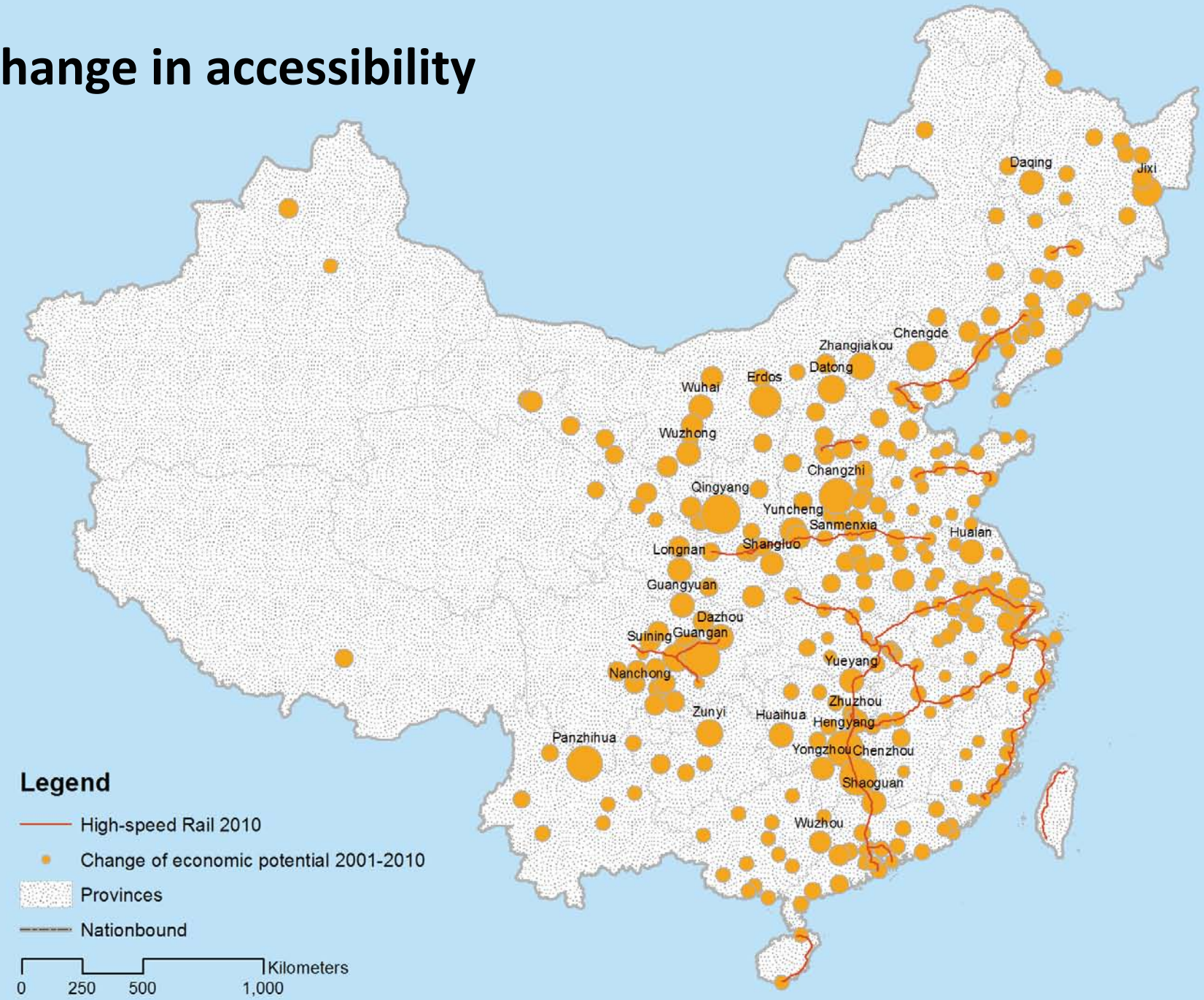
- ***Ridership:*** Since high-speed rail service in China was introduced on April 18, 2007, daily ridership has grown from 237,000 in 2007 to **1.33 million in 2012**, making the Chinese HSR network the most heavily used in the world.


Nightlights of China 2012
Bohai Bay
Yangtze River Delta
Pearl River Delta

Accessibility levels

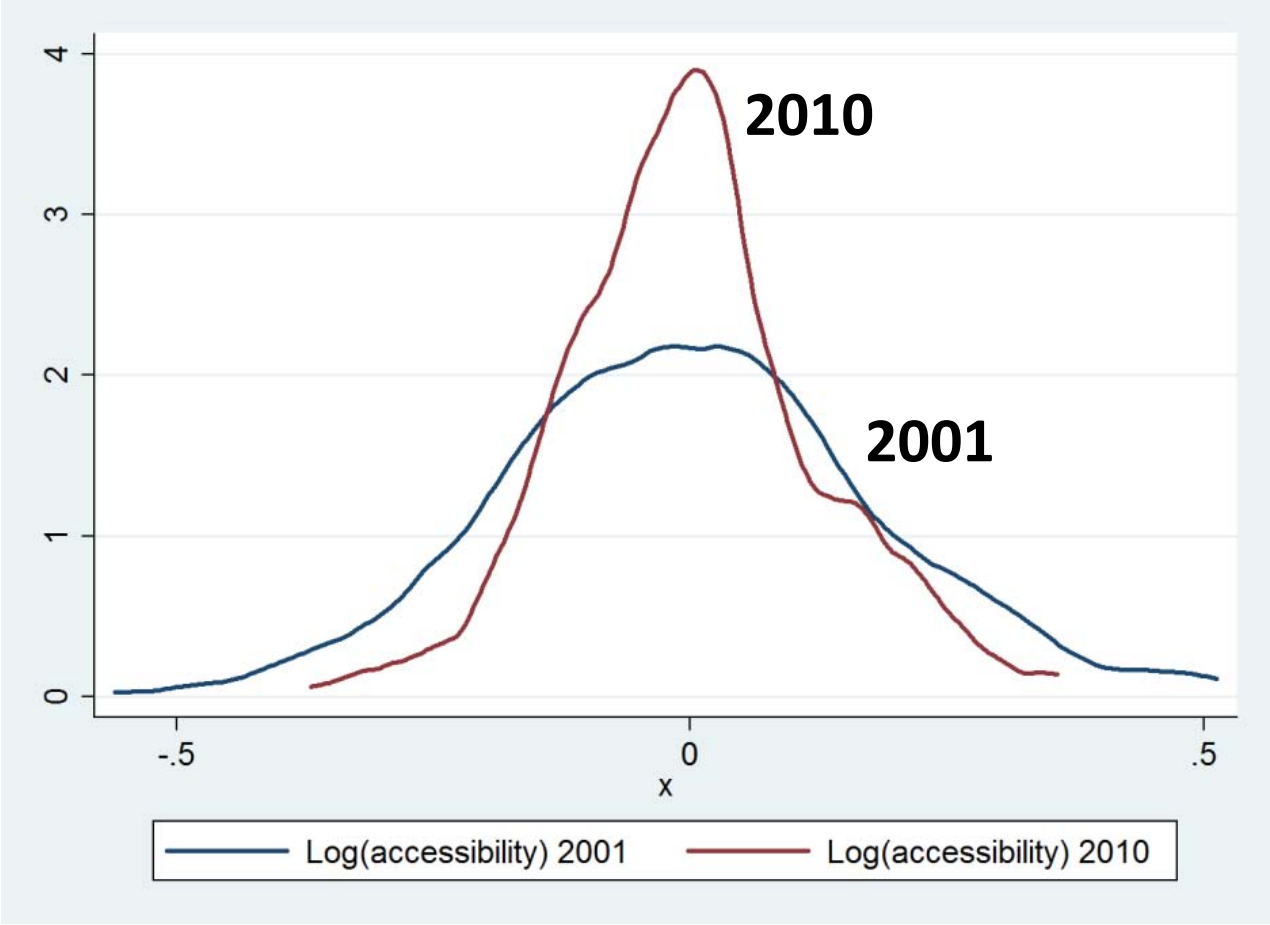


Change in accessibility



Findings

❑ Reduce disparities in accessibility



Coefficient of variation (CV) dropped by **50%**

Findings

- **The Role of HSR in shaping accessibility**
  - Improve accessibility significantly compared to a no-HSR counterfactual scenario as of 2010:

    (average increase of **17%**, maximum **157%**)
  - Most affected cities: **lower-tier** cities in **inland regions**

Economic Impacts

❑ Key inquiries

- How do accessibility influence urban economic activities:
  1) Beneficial or detrimental?
  2) Generative or distributive?
  3) Divergent or convergent?
  4) Decreasing return to accessibility?

❑ Method

- Econometric modeling using panel data

Conceptual model

- **Add accessibility to endogenous growth model**

$$Y_i = A(R_i, M_i) f[K(k_i, M_i), L(l_i, M_i)]$$

Generative | Redistributive

M_i --- accessibility

R_i --- level of local innovative activities

K, L --- the *effective* inputs of capital and labor

Estimation results

❑ Fixed-effect estimations using the whole sample

VARIABLES	Dependent variables in logarithm form						
	GDP	Population	Per cap GDP	Wage rate	Total employment	Agency employment	Private employment
Ln(accessibility)	0.013	-0.040	0.062	0.177***	-0.121**	-0.124**	-0.081
	(0.052)	(0.033)	(0.053)	(0.037)	(0.058)	(0.048)	(0.105)
Observations	2,595	2,595	2,595	2,595	2,585	2,595	2,580
R-squared	0.341	0.217	0.104	0.173	0.365	0.098	0.469

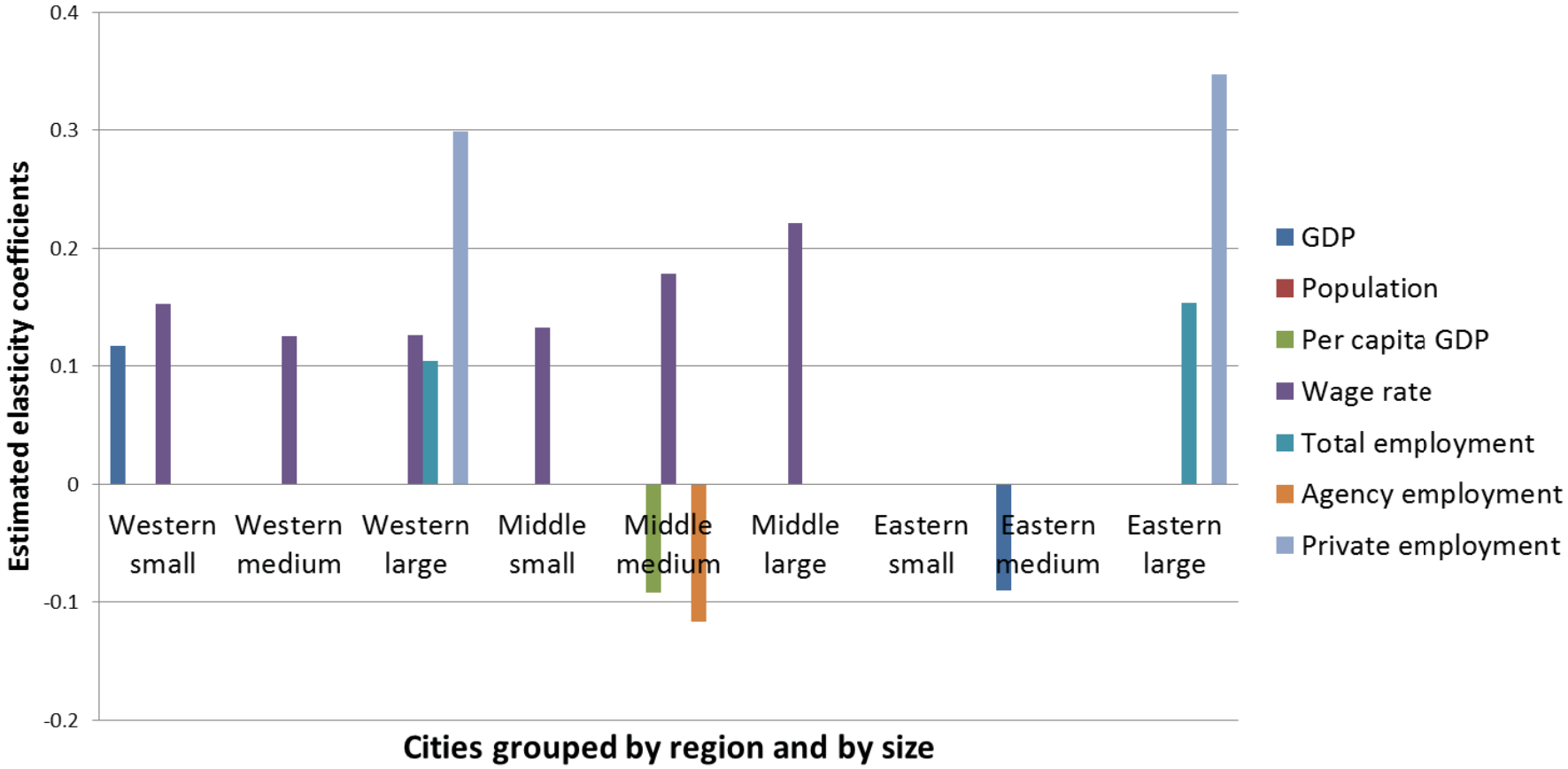
VARIABLES	Dependent variables in logarithm form						
	IT* employment	Finance* employment	FDI	Property price	Real estate investment	Tourism revenue	Number of tourists
Ln(accessibility)	0.227**	0.180*	0.365*	-0.074	0.063	0.544***	0.180*
	(0.111)	(0.093)	(0.202)	(0.053)	(0.132)	(0.135)	(0.102)
Observations	2,059	2,074	2,405	2,328	2,591	2,278	2,285
R-squared	0.130	0.326	0.327	0.028	0.421	0.371	0.714

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

*Note: Consistent statistics for these indicators available for 2003-2010 due to redefinition of industrial sectors.

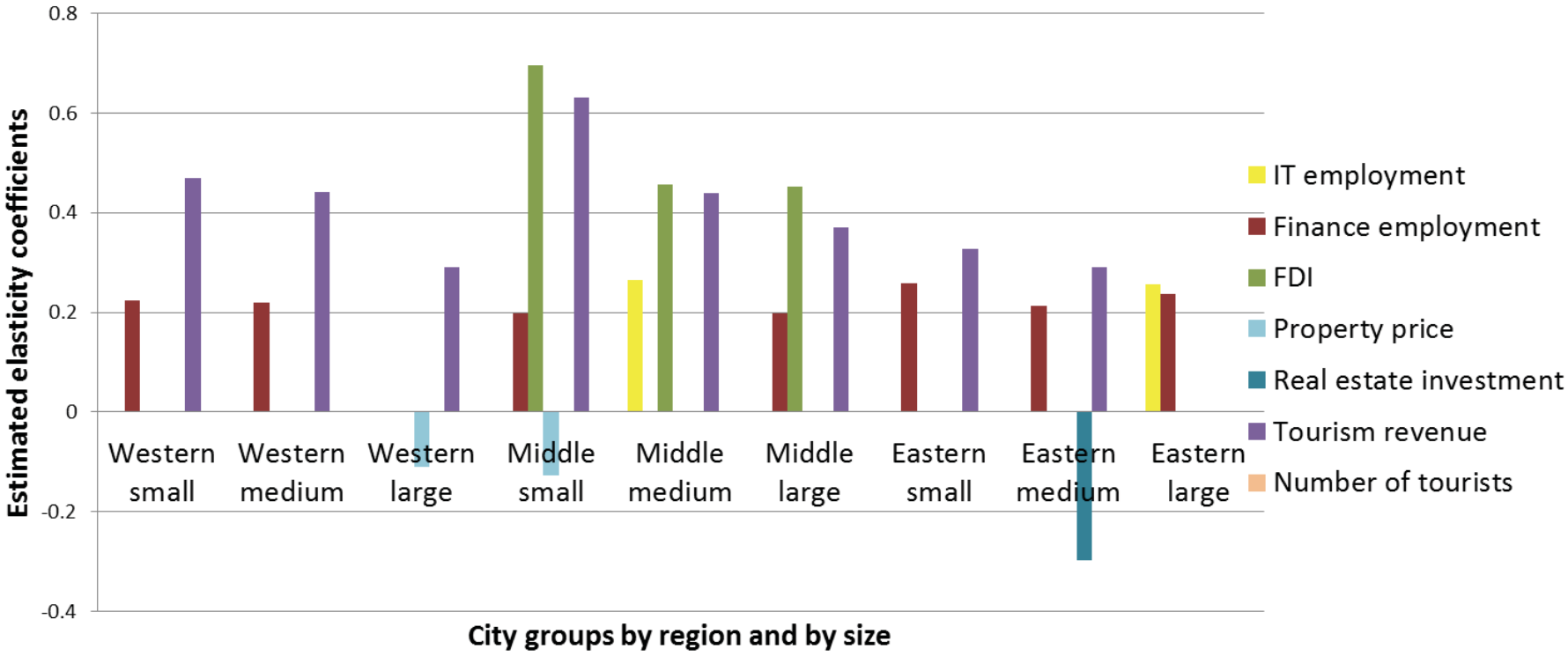
Regional + city size effects

❑ **Elasticity coefficients by sub-groups: general indicators**



Regional + city size effects

- Elasticity coefficients by sub-groups: sectoral indicators



Recap the findings

- **Accessibility patterns**
  - HSR significantly reduced the gaps in intercity accessibility, particularly in low-tier cities
- **Economic impacts**
  - Positive and generative impacts on productivity
  - Redistributive impacts on employment and capital flows
  - Particularly positive impacts on travel-dependent services
  - No evidence of decreasing return to accessibility

Q & A

Policy implications

- **How to choose from alternative transport projects?**
  - Project prioritization based on accessibility improvement
  - Integrate sectoral investment plans, which requires institutional changes in current administrative structure

Policy implications

- **How to include agglomeration in project appraisal?**
  - Keep in mind that different impacts may offset each other

1) Include **generative** impacts to calculate the economic internal rate of return (EIRR)
2) Evaluate divergent or convergent trends of regional disparities with **redistributive** effects
3) Avoid overbuilding through identification of **saturation** effects

Policy implications

❑ Should China invest in HSR?

- Socio-economic reasons
  1) Reduce accessibility gaps at a massive scale
  2) Release capacity for freight transport on regular rails
  3) Reshape urban hierarchy
  4) Optimize allocation of production factors
- Non-economic reasons
  1) Energy security (Gas to electricity)
  2) Reduce carbon emissions
  3) Technology development

Thank you!

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